Exhibit A

UNITED STATES DISTRICT COURT
DISTRICT OF PUERTO RICO

In re: THE FINANCIAL OVERSIGHT AND MANAGEMENT BOARD FOR PUERTO RICO, as representative of PUERTO RICO ELECTRIC POWER AUTHORITY Debtor.	PROMESA Title III No. 17-BK-4780-LTS (Jointly Administered)

EXPERT REPORT OF GLENN R. GEORGE, MBA, PE, PHD

April 28, 2023

Table of contents

List of tables

Abbreviations used in this report

The following is an alphabetized list of abbreviations and defined terms used in this report. If not otherwise defined herein, the abbreviations or defined terms will take the meaning assigned to them in the body of this report, and if not defined therein, in the Modified Second Amended Plan of Adjustment.

AEO— US Energy Information Administration Annual Energy Outlook

CapEx—Capital expenditure(s)

CILT—Contributions in lieu of taxes

CVI—Contingent value instrument

EIA—US Energy Information Administration

FEMA—Federal Emergency Management Agency

FY—Fiscal year

GWh—Gigawatt-hour

IRP—Integrated Resource Plan

kWh—kilowatt-hour

LNG—liquefied natural gas

LR—Long-run

MWh—Megawatt-hour

NPV—Net present value

NREL—National Renewable Energy Laboratory

PPOA—Power Purchase and Operating Agreement

O&M—Operations and maintenance

PREB—Puerto Rico Energy Bureau

PREPA—Puerto Rico Electric Power Authority

PROMESA—Puerto Rico Oversight, Management, and Economic Stability Act

PV—Photovoltaic, a solar energy technology which produces electricity directly through the photoelectric effect

RFO—Residual fuel oil, sometimes known by its US Navy specification, Bunker-C

SAIDI—System Average Interruption Duration Index

SAIFI—System Average Interruption Frequency Index

SOW—Share of wallet, a widely used measure of utility (and electricity) rate affordability

SR—short-run

T&D—Transmission and distribution

TOU—Time of use

WTI—West Texas Intermediate, oil price benchmark

I. Introductory matter

I.A. Qualifications

(1) I hold a bachelor's degree (with Distinction) in mechanical engineering from Cornell University, a master's degree in business administration (also with Distinction) from the same institution, and a PhD degree in public policy, with a focus on energy economics, from Harvard University. I completed the full sequence of coursework in microeconomics and other subjects within public policy, an amalgam of political science, law, and economics. My doctoral dissertation was in regulatory economics, a field within industrial organization, in turn a branch of microeconomics.

(2) Subsequent to earning my PhD, I have worked continuously for 28 years as an economic consultant, advisor, and expert in the energy sector, with an ongoing focus, in part, in debt financing, financial modeling, and utility rate design. Over time, I have worked on behalf of a large number of utility companies, public utility commissions, investors, creditors, litigants, intervenors, and government agencies in the arenas of utility ratemaking, cost recovery, and associated financial projections. My rate design work has been adopted in several US states and overseas jurisdictions, including for example Japan in its 2016 electric power market redesign.

(3) My work experience includes several years as Co-Head of the International Energy Capital Markets group at Nomura Securities, a Japanese securities firm, where I was responsible for originating, structuring, and underwriting fixed-income securities in the electric utility industry and broader energy sector globally. My work included involvement in both corporate and municipal bonds, and in the latter case both general obligation bonds and revenue bonds.

(4) My *curriculum vitae* appears at **Appendix A.** A list of documents relied upon in the preparation of this report appears at **Appendix B**.

(5) Bates White is being paid $950 per hour for my services in this matter. Neither my firm's compensation nor my own is in any way contingent upon my opinions in, or the outcome of, this litigation.

(6) I reserve the right to express additional opinions, to amend or supplement the opinions in this report, or to provide additional rationale for these opinions as additional documents are produced, transcripts of fact and expert witness depositions become available for my review, and new facts are introduced during discovery and trial. I also reserve the right to express additional opinions in response to any opinions offered by other experts.

I.B. Scope of opinions

(7) I have been engaged by Proskauer Rose LLP ("Proskauer" or "Counsel") in its capacity as counsel for the Financial Oversight and Management Board for Puerto Rico (the "Oversight Board") in connection with the Confirmation Hearing for the Title III Plan of Adjustment of the Puerto Rico Electric Power Authority, or "PREPA" (as it may be amended, modified, or supplemented, the "Plan of Adjustment" or "Plan").

(8) I have been asked to provide my expert opinion on the methodology applied by the Brattle Group, Inc. ("Brattle"), at the direction of the Oversight Board, in determining the Legacy Charge in the Plan of Adjustment. More specifically, I have been asked to opine on (i) whether the Legacy Charge provides PREPA's creditors with reasonable recoveries on their claims given PREPA's need to continue operations, as well as the burden on ratepayers and the Puerto Rico economy of increased rates; (ii) whether the methodology used by Brattle to determine the Legacy Charge is appropriate; and (iii) whether the design of the Legacy Charge is consistent with principles of just and reasonable rates.

(9) This report sets out my expert opinions in relation to these topics.

(10) Section II provides some background information on PREPA's customer base and PREPA's general economic outlook. Section III addresses the appropriateness of the methodology applied to determine the Legacy Charge and the reasonable degree of recovery creditors can expect. Finally, Section IV reviews some of the risks associated with estimating the Legacy Charge.

I.C. Summary of opinions

(11) I have reviewed the two component models prepared by Brattle which the Oversight Board has considered in its determination of the Legacy Charge, in order to obtain a working understanding of the data and analyses contained therein.[1] I will refer to the two models as the Revenue Envelope Model and the Legacy Charge Model from time to time throughout this report. As noted above, I examined these models to assess the appropriateness of the methodology, including inputs and assumptions, used by the Oversight Board to derive the Legacy Charge.

(12) I have similarly reviewed the data, documents, and related academic literature which were relied upon to support the modeling methodology, as well as the underlying assumptions used to derive the Legacy Charge. I supplemented my review of the aforementioned materials with my own independent

[1] "Revenue Envelope and Legacy Charge Model_protected.xlsx" (Document ID 235394) ("*Revenue Envelope and Legacy Charge Model.xlsx").*

research and review of the relevant academic literature and data. I also conducted an interview with Brattle to gain a better understanding of the modeling methodology and how the models function.

(13) In my review of the Revenue Envelope Model and Legacy Charge Model, I identified no material calculational errors or divergence from practices generally applied in the field of utility ratemaking. In my opinion, the approach taken in the two models was broadly consistent with practices applied in my field of expertise and was appropriate in reaching a rate that ensures PREPA's continuing operations and attempts to limit its loss of customers and future revenue needed to service debt.

(14) In my opinion, revenue generated from the Legacy Charge represents the upper bound of cash which can reasonably be made available for debt repayment, given the already high burden on PREPA's ratepayers and PREPA's need to continue operations and modernize its system, among other requirements.

(15) The concept of just and reasonable rates is common to the field of public utility ratemaking. Just and reasonable rates are those which allow the utility company to be compensated for prudently incurred costs and the opportunity to earn a return on and of the utility's investments in assets used and useful in providing service to ratepayers.[2] In addition to raising revenues for debt repayment under certain customer affordability constraints, the Legacy Charge appropriately considers the need for additional capital expenditures ("CapEx") and the underrecovery of fixed costs due to lost revenues caused by higher rates ("Fixed Cost Underrecovery"). In my opinion, the models used to derive the Legacy Charge are broadly consistent with the principles of just and reasonable rates.

[2] John Wolfram, "Utility Rates: Fair, Just and Reasonable," *Catalyst Consulting LLC* (2013), http://www.catalystcllc.com/articles/utility-rates-fair-just-and-reasonable/#:~:text=From%20the%20utility%20perspective%2C%20the,recover%20their%20prudently%2Dincurred%20costs.

II. The Puerto Rico electrical grid is one of the least reliable and most expensive for customers among all US states and territories

(16) When considering whether to impose higher rates on PREPA's customers to fund legacy debt payments, one must first consider several extenuating factors. PREPA's customers already pay more for electricity than the average ratepayer in the mainland United States, both in terms of the rate (in cents per kilowatt-hour, or "kWh") and the share of wallet ("SOW"), i.e., the share of household income devoted to energy expenses. Despite high rates, PREPA's customers receive the lowest quality and least reliable service in the US based on pertinent metrics, with PREPA experiencing outages with a duration and frequency significantly higher than those experienced by utilities on the mainland. It is well known that PREPA must implement costly improvements to its generation, transmission, and distribution assets to transform itself into a more modern, resilient, and reliable utility.[3]

II.A. PREPA's customers already pay high rates for electricity relative to ratepayers in the mainland US

(17) PREPA's customers already pay very high electricity rates. As of January 2023, the average mainland US ratepayer paid 15.5 cents per kWh for electricity, while the average cost of electricity in Puerto Rico was 24 cents per kWh.[4] Furthermore, PREPA's revenue requirement has risen in recent years, due largely to high fuel costs. High oil and gas prices have at times caused electricity prices to exceed 30 cents per kWh, in part because Puerto Rico's electricity generation fleet is largely powered by petroleum products and natural gas.[5]

(18) PREPA's 2022 Fiscal Plan (the "2022 Fiscal Plan") states that the SOW of electricity costs for residential customers in Puerto Rico was about 5.6% in 2021, whereas in the southeastern US the SOW was about 3.2% in 2019.[6] The median household income in Puerto Rico (2017-2021, in 2021 dollars) was $21,967, with 40.5% of the population living in poverty.[7] By contrast, the US state with

[3] FOMB - Certified PREPA 2022 Fiscal Plan, June 28, 2022 (FOMB_PREPA 00000699-882), Chapter 2 ("PREPA 2022 Fiscal Plan").

[4] US Energy Information Administration (Electric Power Monthly; Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, January 2023 and 2022 (cents per kilowatt-hour); accessed April 17, 2023), https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a. and US Energy Information Administration, January 2023, "sales_revenue.xslx", "Monthly-Ter" sheet. https://www.eia.gov/electricity/data/eia861m/xls/sales_revenue.xlsx.

[5] US Energy Information Administration, January 2023, "sales_revenue.xslx", "Monthly-Ter" sheet. https://www.eia.gov/electricity/data/eia861m/xls/sales_revenue.xlsx.

[6] PREPA 2022 Fiscal Plan, Exh. 8.

[7] The average Puerto Rican household is 2.74 people. At that size, the poverty line is defined as income somewhere between $16,379 and $21,831 in 2021, depending on the age of household members. US Census Bureau, QuickFacts

the highest poverty rate was Mississippi, with 19.4% of its population living in poverty. The median household income in Mississippi (2017-2021, in 2021 dollars) was $49,111.[8]

(19) Due to the already high burden of electricity costs and low median household incomes, relatively few residents of Puerto Rico can afford significant increases in their electricity bills. Higher electricity bills would likely incentivize some combination of adoption of distributed generation (e.g., rooftop solar photovoltaic ("PV") panels), decreased consumption (e.g., through increased energy efficiency measures), or non-payment of electricity bills.

II.B. PREPA's generation, transmission, and distribution assets require substantial capital investments

(20) PREPA's quality of service is low compared with mainland US utilities. For example, PREPA is the largest public power utility in the US by the number of customers served. However, PREPA's annual net generation is approximately 12 megawatt-hours ("MWh") per customer, meaning that the load per ratepayer is lower than for many other US utilities.[9]

(21) The 2022 Fiscal Plan notes "[t]he average PREPA customer loses power at least once every 5 to 6 weeks, compared to 1 to 2 times per year for mainland customers."[10] The average age of PREPA's generation assets is over 40 years. Some of its units are indefinitely out of service, meaning that, on average, only about 60% to 70% of PREPA-owned generation is available for dispatch.[11]

(22) All of PREPA's renewable generation is owned by third parties. Currently, nearly all of PREPA's own generation assets are powered by diesel, natural gas (in turn derived from liquefied natural gas, "LNG"), fuel oil, or coal.[12] In recent years, high oil and gas prices have caused fuel and purchased power to account for the majority of the rates paid by customers. Accordingly, in PREPA's projected revenue requirement for fiscal year ("FY") 2023, fuel and purchased power were expected to account for 67% of rates.[13] PREPA's high dependency on fossil fuels means that the rates charged to customers are subject to the volatility of fuel prices, especially oil.

Puerto Rico. Available at: https://www.census.gov/quickfacts/fact/table/PR/PST045222; US Census Bureau, Poverty Thresholds, 2021, "thresh21.xlsx", accessed April 23, 2023, https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html.

8 US Census Bureau, QuickFacts Mississippi. Available at: https://www.census.gov/quickfacts/fact/table/MS/PST045222.

9 PREPA 2022 Fiscal Plan, p. 19.

10 PREPA 2022 Fiscal Plan, p. 20.

11 PREPA 2022 Fiscal Plan, p. 28.

12 PREPA 2022 Fiscal Plan, Exh. 6.

13 PREPA 2022 Fiscal Plan, Exh. 63.

(23) Technological advances and lower costs have improved the feasibility and attractiveness of distributed generation throughout Puerto Rico. Rooftop solar installations in particular are for many customers a potential substitute for electric utility service, posing a rising competitive threat to PREPA over time. It is recognized that raising rates to service debt obligations would further incentivize rooftop solar adoption, which would ultimately decrease the amount of revenue PREPA can collect, potentially undermining PREPA's financial stability.[14] Under Act 17-2019, customers who use rooftop solar or other distributed generation can offset the energy they purchase from PREPA by exporting energy to the grid, at the prevailing retail rate in cents per kWh.[15] Indeed, the National Renewable Energy Laboratory ("NREL") estimates that over 78% of residential customers have the technical potential to install rooftop solar in Puerto Rico.[16]

(24) PREPA's transmission and distribution ("T&D") systems are also in need of significant upgrades. The majority of PREPA's generation assets are in the southern part of the island, while the primary load center is in the north. All three transmission loops which link the south to the north run through mountainous and forested terrain, making repairs and maintenance difficult.[17] The capital budget for T&D each year is composed of both federally funded and ratepayer-funded programs.[18] Notably, some federal funding (limited to certain identifiable projects and limited in duration) "comes with a 10-25% cost-share requirement" that PREPA must cover, for both generation and T&D projects.[19]

(25) PREPA has a history of underinvesting in its T&D systems, which leaves it "highly susceptible to damage from hurricanes, earthquakes, and other unforeseen events."[20] This is evidenced by its System Average Interruption Duration Index ("SAIDI") and System Average Interruption Frequency Index ("SAIFI"), each of which is approximately nine times greater than its peer group median.[21] Hurricanes may be more severe in the Caribbean in coming years, posing additional concerns that PREPA must consider in its efforts to modernize its generation and T&D systems.[22]

(26) In particular, it is difficult to overstate the devastating impacts of Hurricanes Maria and Irma in 2017 on PREPA's generation and T&D systems. These events demonstrated that PREPA's systems were unprepared for severe hurricanes, the cumulative effect of which could be to leave PREPA's systems

[14] PREPA 2022 Fiscal Plan, p. 169.

[15] PREPA 2022 Fiscal Plan, p. 34.

[16] Meghan Mooney and Katy Waechter, December 17, 2020, "Puerto Rico Low-to-Moderate Income Rooftop PV and Solar Savings Potential," p. 19.

[17] PREPA 2022 Fiscal Plan, p. 27.

[18] LUMA Submission of Annual Budget, April 2, 2022 (FOMB_PREPA 00020540-21007), Exhibit 1, p. 17.

[19] PREPA 2022 Fiscal Plan, p. 86.

[20] PREPA 2022 Fiscal Plan, p. 23.

[21] PREPA 2022 Fiscal Plan, p. 21.

[22] Environmental Defense Fund, "How climate change makes hurricanes more destructive," https://www.edf.org/climate/how-climate-change-makes-hurricanes-more-destructive#:~:text=Stronger%20hurricanes%20are%20becoming%20more,Ocean%20has%20doubled%20since%201980.

in an ever-more vulnerable position. In 2017, "over 2,700 transmission poles were damaged…41% of substations suffered major damage…75% of circuits were damaged while certain generating systems also suffered significant damage."[23] It subsequently took PREPA around 11 months to restore power to all of its customers.[24]

(27) While Puerto Rico is supposed to receive approximately $10 billion in federal funds for PREPA's use,[25] this is not enough to rebuild the grid and fix PREPA's T&D system. According to multiple sources, rebuilding PREPA's T&D system will require billions of dollars in addition to the moneys appropriated by the federal government.[26]

II.C. PREPA is a heavily indebted entity, but its capacity to impose higher rates to repay debt is limited by its operational needs and the high burden on its customer base

(28) PREPA has incurred an unsustainable debt burden, which currently includes approximately $8.5 billion in claims from bondholders, $700 million in fuel purchase loans, and an unfunded pension liability of over $3 billion.[27] This excludes non-bond general unsecured claims.

(29) Without any debt restructuring, PREPA would have to raise its rates by approximately six to eight cents per kWh.[28] As I discuss in more detail above, in Section II.A, PREPA's customers already pay high electricity rates relative to US customers, yet the population of Puerto Rico is on average poorer than that of any US state. Even with debt restructuring, rates must be raised to cover restructured debt and pension obligations. However, PREPA must also cover other costs, including CapEx and Fixed Cost Underrecovery, which would be associated with imposing higher rates to service debt.

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[23] PREPA 2022 Fiscal Plan, p. 67.

[24] Max Zahn, "Puerto Rico's power grid is struggling 5 years after Hurricane Maria. Here's why," *ABC News*, September 22, 2022, https://abcnews.go.com/Technology/puerto-ricos-power-grid-struggling-years-hurricane-maria/story?id=90151141#:~:text=When%20Hurricane%20Maria%20made%20landfall,longest%20blackout%20in%20U.S.%20history.

[25] Puerto Rico Electric Power Authority and US Federal Emergency Management Agency, PREPA 10-Year Infrastructure Plan, March 2021, p. 9.

[26] *See* e.g. Autoridad de Energia Electrica and Central Office for Recovery, Reconstruction, and Resiliency, The Grid Modernization of Puerto Rico, available at: https://recovery.pr.gov/documents/Grid%20Modernization%20for%20Puerto%20Rico-English1.pdf; *see also* LUMA letter to Proskauer re CapEx (February 7, 2023) (FOMB_PREPA 00023701-704).

[27] *Disclosure Statement for Modified Second Amended Title III Plan of Adjustment of the Puerto Rico Electric Power Authority*, No. 17-BK-3283-LTS and No. 17-BL-4780-LTS, March 1, 2023, p. 8 ("Disclosure Statement").

[28] This estimate includes rate adjustments for PREPA's pension obligations. PREPA 2022 Fiscal Plan, p. 168 and Exh. 68.

(30) In Section III, below, I discuss the Oversight Board's approach in designing the Legacy Charge that attempts to maximize recoveries to PREPA's legacy creditors in light of the challenging circumstances facing PREPA and its customers.[29]

[29] This discussion is also reflected in Exhibit P of the Disclosure Statement.

III. The methodology applied by the Oversight Board to determine the Legacy Charge is logical and reasonable

(31) Broadly speaking, the Oversight Board (acting through its retained consultant Brattle) used a two-step methodology to derive the Legacy Charge.

(32) First, the Oversight Board relied on the Revenue Envelope Model to estimate the upper bound of incremental revenues—in addition to the revenue requirements defined in the 2022 Fiscal Plan—while remaining within certain economic and societal limitations. This upper bound on revenue is known as the "Revenue Envelope." The Revenue Envelope Model estimates the fixed and volumetric charges required to generate the Revenue Envelope over a 28-year forecast period (the same period used in the 2022 Fiscal Plan). To estimate the Revenue Envelope, the Oversight Board took into consideration a number of factors, including customers' willingness and ability to pay higher rates, and the future sustainability of PREPA as a going concern. The Revenue Envelope represents the upper bound on revenue which could reasonably be available for debt repayment, capital expenditures, and other prudent PREPA expenses.

(33) Second, the Oversight Board tailored the specific charge assessed to each customer class based in part on a number of factors, including the fixed and volumetric charges derived in the Revenue Envelope Model, PREPA's current rate structure, and the relative burden of increased rates on each customer class. The Legacy Charge proposed by the Oversight Board was designed to generate the revenues available for debt repayment ("Legacy Charge Revenues") beginning in FY 2024 over a 35-year period, through FY 2058.[30] Specifically, "[t]he Plan of Adjustment specifies that payment of the New Bonds will be funded through an increase in Net Revenues generated through the imposition and collection of a Legacy Charge added to the bills of PREPA's customers [i.e., Legacy Charge Revenues]."[31]

(34) It should be noted that many of the modeling inputs and assumptions for both models were based on data and forecasts contained the 2022 Fiscal Plan. I have been instructed that the Puerto Rico Oversight, Management, and Economic Stability Act ("PROMESA") imposes the 2022 Fiscal Plan regardless of other parties' objections. As such, my critique of the Revenue Envelope Model and Legacy Charge Model is limited to the methodology and assumptions specific to each model.

30 Note that 2022 Fiscal Plan forecasts are for 28-years whereas the repayment term for the New Bonds is 35-years. Detail on the structure and repayment schedule of the New Bonds that the Legacy Charge Revenues will fund can be found in *Modified Second Amended Title III Plan of Adjustment of the Puerto Rico Electric Power Authority*, No. 17-BK-3283-LTS and No. 17-BL-4780-LTS, March 1, 2023, Article XIX, p. 43 ("Plan of Adjustment").

31 Disclosure Statement, Exhibit P.

(35) In Section III.A and Section III.B, below, I discuss the reasonableness of the methodology and key assumptions of the Revenue Envelope Model and Legacy Charge Model, respectively.

III.A. The Revenue Envelope Model logically derives the upper bound of incremental revenues that PREPA can raise from its customers

III.A.1. The upper bound of affordability for a typical PREPA residential customer's monthly electricity bill is calculated based upon reasonable assumptions

(36) The Revenue Envelope Model relies on a number of factors to estimate an affordable Revenue Envelope for PREPA's customers. These factors include the monthly electricity bill that a typical PREPA residential customer can afford (based on the estimated median annual household income, a SOW affordability constraint, and median monthly electricity consumption) and PREPA's rate structure from the 2022 Fiscal Plan.

(37) Footnote 3 of Exhibit P in the Disclosure Statement for Modified Second Amended Plan of Adjustment ("Disclosure Statement") addresses the methodology for determining the median annual income of a household in Puerto Rico.[32] I have reviewed the methodology described therein and find it to be sound and reasonable. The approach relies upon US Census data from 2021, which estimates the *median* household income for Puerto Ricans to be $21,967. This is to say that 50% of households earn more than $21,967 and 50% earn less. The inflation adjustments per the 2022 Fiscal Plan are then applied to estimate the median annual household income in Puerto Rico to be $24,000 in 2024.

(38) In comparison, according to the Census Bureau the *mean* household income in 2021 for Puerto Rico was approximately $35,000.[33] However, the mean (arithmetic average) is influenced by outliers with high household incomes, whereas the median is not influenced by the same outliers. Moreover, as of 2021, more than half of households in Puerto Rico earned less than $25,000 and nearly 40% of families lived below the poverty line.[34] Accordingly, median rather than mean household income is in my opinion the appropriate starting point for calculating the upper bound for affordability. I find the

[32] See Footnote 3 of Exhibit P of the Disclosure Statement. The median 2021 household income—estimated to be $21,967 in 2021 dollars—was adjusted for inflation pursuant to the 2022 Fiscal Plan assumptions to arrive at the estimated 2024 median household income of $23,824. This amount was rounded up to the nearest thousand dollars to arrive at $24,000. The estimate is reported in 2024 dollars because the Legacy Charge is expected to be implemented in 2024. Moreover, the Census Bureau noted that household income reporting in the 2020 Survey may include non-recurring federal income support (e.g., COVID relief and stimulus payments), which would tend to inflate household incomes.

[33] "Puerto Rico Population and Demographics," *Name Census*, https://namecensus.com/demographics/puerto-rico/.

[34] According to the US Census Bureau, in 2021, the poverty line for a household of three was considered to be between $21,196 to $21,831 depending on the number of children in the household. See The United States Census Bureau, Poverty Thresholds, 2021, "thresh21.xlsx", accessed April 24, 2023, https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html. "Puerto Rico Population and Demographics," *Name Census*, https://namecensus.com/demographics/puerto-rico/.

estimated median household income of $24,000 to be within the plausible range for a typical household in Puerto Rico.

(39) The Revenue Envelope Model defines the upper bound of electricity affordability for residential customers in Puerto Rico as a percentage of median household income, or share of wallet, to be 6% (i.e., a 6% SOW).[35] Both the literature of energy affordability in the mainland US and ratemaking policies in several jurisdictions suggest that a 6% SOW is an upper bound of affordability. This 6% affordability threshold is based in part on researchers' understanding that housing costs should typically account for no more than 30% of household income and no more than 20% of these household costs should be allocated to energy bills.[36] Together, these statistics indicate that household energy costs should be no greater than 6%. The 6% SOW is also used as a metric in policymaking and rate-setting. Multiple states and public utilities commissions (including Connecticut, Colorado, Nevada, New York, and Oregon) have implemented policies to assist low-income households to keep energy burdens below 6% SOW.[37] However, none of these jurisdictions impose a median of 6% SOW. In fact, the national median SOW is much lower.[38]

(40) Indeed, a 6% SOW is often defined as a high energy burden. As of 2017, more than 25% of US households (30.6 million) faced a "high energy burden" (i.e., SOW of more than 6%).[39] In the "South Atlantic" region (essentially the Middle Atlantic and Southeastern states), the median energy burden is 3.2%.[40] By comparison, because the SOW calculation is based on median household income, this suggests that around half of households in Puerto Rico would spend more than 6% of their household income on electricity. In other words, about half of Puerto Rico residents would face a "high energy burden" as a result of the Legacy Charge, further suggesting that the 6% SOW constraint for determining the Legacy Charge represents an upper bound on revenue available to service the New Bonds.

(41) Taken together, the estimated median household income in 2024 for PREPA's residential customers and the 6% SOW yield a maximum monthly electricity bill of $120, as shown in **Table 1** below.

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35 When discussing the SOW for PREPA customers it will exclusively pertain to electricity costs since nine out of ten Puerto Rican households do not have a heating system. See US Energy Information Administration, "Puerto Rico Territory Energy Profile," January 19, 2023 (accessed April 25, 2023), https://www.eia.gov/state/print.php?sid=RQ.

36 Ariel Drehobl *et al.*, "How High Are Household Energy Burdens?", *American Council for an Energy-Efficient Economy* (September 2020), p. ii; Marilyn A. Brown *et al.*, "Low-Income Energy Affordability: Conclusions from a Literature Review," *Oak Ridge National Laboratory* (March 2020), p. 8.

37 High energy burden definition, January 4, 2023, (FOMB_PREPA 00023698-699); *Ten-Year Plan: Reducing the Energy Burden in Oregon Affordable Housing*, Oregon Department of Energy, Oregon Public Utility Commission, and Oregon Housing and Community Services, 2018.

38 PREPA 2022 Fiscal Plan, Exh. 8.

39 Ariel Drehobl *et al.*, "How High Are Household Energy Burdens?", *American Council for an Energy-Efficient Economy* (September 2020), p. ii.

40 Ariel Drehobl *et al.*, "How High Are Household Energy Burdens?", *American Council for an Energy-Efficient Economy* (September 2020), p. 14.

Table 1: Determining the upper bound of an affordable monthly electricity bill for PREPA's residential customers

Component	Amount
Estimated median annual household income (2024) [a]	$ 24,000
Maximum annual affordable electricity bill as a percent of income [b]	6%
Maximum monthly affordable electricity bill = [a] x [b] / 12	$ 120

(42) The actual SOW for electricity for residential customers in Puerto Rico may of course fluctuate over time. Aside from the fact that approximately half of households in Puerto Rico could spend more than 6% of their household income on electricity in 2024 and beyond, there are other uncertainties which could make the actual SOW higher or lower than 6% (e.g., income growth, fuel prices). Given these uncertainties, and since a 6% SOW is already a high energy burden, it would be imprudent in my opinion to set a SOW higher than 6% or to leave such a high burden on half of PREPA's customers for 35 years or more.

III.A.2. The proposed Legacy Charge rate design balances the need to raise additional revenues while mitigating the reduction in sales due to rate increases

III.A.2.a. The selected price elasticities of demand by customer class fall within a reasonable range

(43) The price elasticity of demand for electricity is a common area of study in the utility world. As utility rates rise, customers are incentivized to reduce consumption or find alternative sources of electricity. One such alternative is a distributed generation solution like rooftop solar PV, which Puerto Rico is particularly suitable for.[41] Customers are more responsive to price changes in the long-run ("LR"), as they have more time to adjust consumption habits or to adopt rooftop solar PV, for example.[42] Conversely, in the short-run ("SR"), customers are less responsive to price changes.

(44) Multiple factors may affect a customer's price elasticity of demand for electricity, including income, geography, time period, the availability of energy efficiency programs and incentives, and building

[41] Meghan Mooney and Katy Waechter, "Puerto Rico Low-to-Moderate Income Rooftop PV and Solar Savings Potential," *The National Renewable Energy Laboratory* (December 17, 2020).

[42] I recognize that studies in the literature often differ on their definitions of SR and LR elasticities. I note that the Revenue Envelope Model considers ten years as the LR elasticity time period, which is typical in the literature. See, e.g., Paul J. Burke and Ashani Abayasekara, "The Price Elasticity of Demand in the United States: A Three Dimension Analysis," *The Energy Journal* 39, no. 2 (2018), (FOMB_PREPA 00022494); Tatyana Deryugina *et al.*, "Long(er)-Run Elasticity of Electricity Demand: Evidence from Municipal Electric Aggregation," (working paper, National Bureau of Economic Research, 2017); and James Feehan, "The long-run price elasticity of residential demand for electricity: Results from a natural experiment," *Utility Policy*, 51 (2018), pp. 12-17.

design characteristics.[43] Some studies suggest that high-income customers may have a higher price elasticity of demand because, relative to low-income customers, they have more ability to change their behavior and find alternatives, especially in the LR.[44] Other studies suggest that low-income customers may have a higher price elasticity of demand, relative to high-income customers, because high electricity prices represent a bigger burden for them.[45]

(45) The effects of the price elasticity of demand for electricity have the potential to lead to broader negative macroeconomic effects, as residential customers and businesses alike choose to relocate or significantly reduce their consumption in response to substantial electricity price increases. These effects could be significant over time for an island economy like Puerto Rico's, which has already been buffeted by natural disaster, demographic decline, and deindustrialization. At the same time, decreased electricity consumption would lead to less revenue for PREPA and further undermine PREPA's ability to update T&D systems and prepare for future natural disasters. For these reasons there are limits to how far PREPA can raise rates before wider-ranging problems ensued, which would threaten the viability of PREPA and the economy of Puerto Rico.

(46) I performed an extensive review of the academic literature with respect to the price elasticity of demand for energy and, more specifically, electricity. **Table 2** below summarizes the SR and LR elasticity results from several of the studies I have considered during the course of my literature review, focusing on residential customers.

43 Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89).

44 Isabella Schulte and Peter Heindl, "Price and income elasticities of residential energy demand in Germany," *Energy Policy* 102 (2017), pp. 512-528.

45 Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89), p. 4; Xavier Labandeira *et al.*, "A meta-analysis on the price elasticity of energy demand," *Energy Policy* 102 (January 2017), pp. 554, 549-568.

Table 2: Summary of price elasticities of demand for electricity for residential customers[46]

Price elasticity of demand study	Geography	SR price elasticity	LR price elasticity
Alberini and Filippini (2011)	US states	-0.10	-0.70
Deryugina *et al.* (2017)	Illinois	-0.14	-0.29
Labandeira *et al.* (2017)	Global	-0.20	-0.51
Ros (2017)	N/A	N/A	-0.40
Sun and Yu (2017)	US states	-0.10	-1.00
Zhu *et al.* (2018)	Global	-0.23	-0.58
Feehan (2018)	Canada	N/A	-1.20
Burke and Abayasekara (2018)	US states	-0.10	-0.95
EIA (2021)	US	-0.13	-0.50
Buchsbaum (October 2022)	California	-0.36	-2.35

(47) I note here that Labandeira *et al.* (2017) and Zhu *et al.* (2018) are meta-analyses which summarize the empirical evidence from numerous studies on the price elasticity of demand for electricity.

a. Labandeira *et al.* (2017) analyzed electricity price changes from 538 studies ranging from 1990-2016 and calculated an average SR elasticity of -0.20 and LR elasticity of -0.51.[47] It is worth noting that price elasticity of demand for electricity studies earlier than, say, the mid-2010s may be less relevant to the topic today. This is due in part to the growth in affordable distributed generation options (e.g., rooftop solar PV) in recent years. As a result, I believe it is appropriate to rely on the most recent elasticity studies because distributed generation solutions have become significantly more economical for residential and commercial customers who wish to switch away (at least partially) from electric utility service.[48]

[46] The coefficients in the SR and LR price elasticity columns from the Labendeira *et al.* and Zhu *et al.* meta-analyses are the mean coefficients. Anna Alberini and Massimo Filippini, "Response of residential electricity demand to price: The effect of measurement error," *Energy Economics* 33, no. 5 (2011), 889-895; Tatyana Deryugina *et al.*, "Long(er)-Run Elasticity of Electricity Demand: Evidence from Municipal Electric Aggregation," (working paper, National Bureau of Economic Research, 2017); Xavier Labandeira *et al.*, "A meta-analysis on the price elasticity of energy demand," *Energy Policy* 102 (January 2017), Table 4, pp. 549-568; Agustin J. Ros, "An Econometric Assessment of Electricity Demand in the United States Using Utility-Specific Panel Data and the Impact of Retail Competition on Prices," *The Energy Journal* 39, no. 2, pp. 73-99; Yanming Sun and Yihua Yu, "Revisiting the Residential Electricity Demand in the United States: A Dynamic Partial Adjustment Modelling Approach," *Social Science Journal*, 54, no. 3 (2017), pp. 295-304; Xing Zhu *et al.*, "A meta-analysis on the price elasticity and income elasticity of residential electricity demand," *Journal of Cleaner Production* 201 (2018), pp. 170-171, 295-304; James Feehan, "The long-run price elasticity of residential demand for electricity: Results from a natural experiment," *Utility Policy*, 51 (2018), pp. 12-17; US Energy Information Administration, *Price Elasticity for Energy Use in the Buildings in the United States* (January 2021); Paul J. Burke and Ashani Abayasekara, "The Price Elasticity of Demand in the United States: A Three Dimension Analysis," *The Energy Journal* 39, no. 2 (2018), (FOMB_PREPA 00022494), Table 2 and Table 4; Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89), Table 8.

[47] Xavier Labandeira *et al.*, "A meta-analysis on the price elasticity of energy demand," *Energy Policy* 102 (January 2017): Table 4, pp. 549-568.

[48] See, e.g., Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity

b. Zhu *et al*. (2018) summarized the SR and LR residential price elasticity of demand for electricity from 175 and 196 studies, respectively. The SR elasticities ranged from -0.95 to 0.61 (mean of -0.23) and LR elasticities ranged from -4.20 to 0.60 (mean of -0.58).[49] As with Labandeira *et al*. (2017), Zhu *et al.* (2018) synthesize studies that were based on data from multiple countries. In this respect, it is worth noting that some regions of the world may have less suitable geographies for residential or commercial distributed generation alternatives, or they might not be available at all, which would affect the price elasticity of demand of electricity. For example, because Puerto Rico is well-suited for rooftop solar PV and the technology is readily available, one might expect its LR price elasticity to be higher.[50] However, even though rooftop solar PV has become more affordable over time, I note that customers must have the credit or disposable income necessary to participate in distributed generation and energy efficiency measures, which some of PREPA's customers cannot afford.

(48) Two of the studies included above are particularly relevant because they are more recent and cover geographic regions similar to PREPA. These are Burke and Abayasekara (2018) and Buchsbaum (October 2022). Indeed, Brattle relies in part on these two studies in its estimation of the price elasticities of demand as implemented in the Revenue Envelope Model.

a. Burke and Abayasekara (2018) examines the SR and LR price elasticities of state-level electricity demand in the US from 2003-2015 by residential, commercial, and industrial sectors.[51] Many other studies analyzed a single sector or all of the sectors combined, so the results of Burke and Abayasekara (2018) provide additional value in this context. Their results show that industrial customers are more price sensitive than residential customers with estimated LR elasticities of -1.17 and -0.95, respectively.[52] Commercial customers, however, have a much lower LR price

customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89); US Energy Information Administration, *Price Elasticity for Energy Use in the Buildings in the United States* (January 2021).

49 Xing Zhu *et al.*, "A meta-analysis on the price elasticity and income elasticity of residential electricity demand," *Journal of Cleaner Production* 201 (2018): pp. 170-171, 169-177.

50 Meghan Mooney and Katy Waechter, "Puerto Rico Low-to-Moderate Income Rooftop PV and Solar Savings Potential," *The National Renewable Energy Laboratory* (December 17, 2020).

51 Paul J. Burke and Ashani Abayasekara, "The price elasticity of electricity demand in the United States: A three-dimensional analysis," *The Energy Journal* 39(2) (2018), (FOMB_PREPA 00022494-517). I note that within this report, I have only reported the non-IV elasticity results from this study.

52 Paul J. Burke and Ashani Abayasekara, "The price elasticity of electricity demand in the United States: A three-dimensional analysis," *The Energy Journal* 39(2) (2018), (FOMB_PREPA 00022494-517), Table 2.

elasticity of demand for electricity relative to residential and industrial customers (-0.34).[53]

b. Buchsbaum performed his analysis on residential PG&E customers in California relying on data from 2008-2020 and estimates the SR price elasticity of demand for electricity to be -0.36 and the LR to be -2.35.[54] The higher estimates might be explained in part by California's geography and climate, the presence of high electricity prices, and the higher adoption rate of rooftop solar PV.[55] Notably, Buchsbaum finds that, in the LR, low-income customers are in fact *more* responsive to changes in price than are high-income customers.[56] This particular finding is relevant to PREPA since, as noted above, nearly 40% of households in Puerto Rico are considered to be below the poverty line. It may also be indicative of the increasing affordability of distributed generation alternatives and the increasing availability of such alternatives for low-income households.

(49) The Revenue Envelope Model incorporated SR and LR price elasticities of demand based on the totality of the literature in the SR and in particular on Burke and Abayasekara (2018) and Buchsbaum (October 2022) in the LR. Different price elasticities are applied to each residential and non-residential customer class.[57] Adjustments were made for certain customer classes based on expert judgment of likely switching behavior for that customer class. [58] For example, I understand that the relatively low average consumption data for the Commercial GSS 211 customer class suggested that these customers were likely small and did not own the buildings they operated in. Therefore, these customers could not readily implement distributed generation alternatives if given the chance and were assigned an elasticity that is smaller in absolute value.

(50) **Table 3** below illustrates the estimated SR and LR price elasticities of demand for electricity for each customer class from the Revenue Envelope Model. The Revenue Envelope Model relies on these

53 Paul J. Burke and Ashani Abayasekara, "The price elasticity of electricity demand in the United States: A three-dimensional analysis," *The Energy Journal* 39(2) (2018), (FOMB_PREPA 00022494-517), Table 2.

54 Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89).

55 Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89), pp. 4-5.

56 Jesse Buchsbaum, "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers," (PhD job market paper, University of California, Berkeley, October 2022), (FOMB_PREPA 00022518-89), p. 4.

57 "LT Elasticity workbook.xlsx", "Derivation" tab (FOMB_PREPA 00022590). I note that elasticities for government and municipal customers are not calculated by Burke and Abayasekara (2018). Accordingly, these customer classes are assumed to have elasticities similar to PREPA's commercial customers with similar consumption habits.

58 "LT Elasticity workbook.xlsx", "Derivation" tab (FOMB_PREPA 00022590). See also Footnote 5 in Exhibit P of the Disclosure Statement.

estimated elasticities to calculate the expected load that would be lost due to increased rates as a result of the Legacy Charge.

Table 3: Estimated price elasticity of demand for electricity by PREPA customer class[59]

Customer class category	Customer class	SR price elasticity	LR price elasticity
Residential	RH3, LRS, RFR	-0.20	-1.70
	GRS 111	-0.20	-1.70
	GRS 112 (Subsidy eligible)	-0.20	-1.70
	GRS 112 (General)	-0.20	-1.70
Commercial	GSS 211	-0.20	-0.68
	GSP 212	-0.20	-1.19
	GST 213	-0.20	-1.70
Industrial	GSS 311	-0.20	-0.85
	GSP 312	-0.20	-0.85
	GST 313	-0.20	-1.28
	TOU-T 363	-0.20	-1.28
	LIS 333	-0.20	-1.28
	TOU-T 963	-0.20	-1.28

(51) For each customer class in the Revenue Envelope Model, the price elasticity of demand starts at the SR elasticity of -0.20 in FY 2024 and then increases at a steady rate over a period of ten years until it reaches the LR elasticity that was estimated for that customer class (see Table 3 above).[60] The elasticities are used to calculate the percentage loss in load each year as a result of the Legacy Charge's increased rates. For example, for residential customers that have reached the LR price elasticity estimate, a 10% increase in prices would yield a 17% reduction in load.

(52) Based on my independent review of the literature and assessment of how the elasticities were estimated by customer class, I believe the elasticities applied, and associated calculations, are reasonable and, indeed, may be conservative given that PREPA's customers may increasingly turn to distributed generation alternatives and energy efficiency strategies as they become more affordable over time. In this context, I note that the US Department of Energy recently announced a conditional loan commitment to Sunnova Energy Corporation's Project Hestia, which aims to provide loans to make distributed generation resources more affordable for low-income households across the US. Notably, Project Hestia plans to provide up to 20% of its loans to homeowners in Puerto Rico.[61]

59 The price elasticities of demand for electricity from commercial customers are also applied for the government and municipal customers. "LT Elasticity workbook.xlsx", (FOMB_PREPA 00022590); *Revenue Envelope and Legacy Charge Model.xlsx,* "RE_Inputs" tab.

60 See the revenue calculations, which contain the yearly elasticity factors, for each customer class in the *Revenue Envelope and Legacy Charge Model.xlsx,* at the following tabs: "Residential Classes", "Commercial Classes", "Government Classes", "Municipality Classes", and "Industrial Classes".

61 Jigar Shah, "LPO Offers First Conditional Commitment for a Virtual Power Plant to Sunnova's Project Hestia to

Programs such as this have the potential to accelerate customer switching behavior away from PREPA and toward rooftop solar and other distributed energy resources.

III.A.2.b. The proposed combination of fixed and volumetric charges appropriately reflects the propensity of customers over time to pursue energy efficiency and demand response alternatives

(53) The Revenue Envelope must be generated using fixed charges, volumetric charges, or a combination of the two. Electric utility rate design, in particular the split between fixed and volumetric charges, has the potential to affect sales to customers as a result of the incentives created. Customers must pay a fixed charge to maintain connectivity to the grid and then a volumetric charge based on their actual electric energy consumption. How a utility determines the split between its rates (e.g., higher fixed charges versus higher volumetric charges) is one way it can mitigate the risks related to the price elasticity of demand for electricity. For example, higher volumetric charges would incentivize customers to reduce their consumption or turn to alternatives (e.g., distributed generation via rooftop solar PV). Conversely, customers typically cannot avoid higher fixed charges unless they disconnect from the grid and become fully energy self-sufficient.

(54) For several years, utilities have pursued increasing the fixed charges they levy on customers, to ensure they are able to collect sufficient revenue regardless of customers' consumption.[62] This has particularly been the case as distributed generation becomes more affordable and the prevalence of renewable energy technologies increases.[63] Utilities' fixed charges do not change as customers decrease their consumption, so fixed charges are likely to remain an important component of electricity bills. For PREPA, levying charges for debt repayment and other prudent expenses through fixed charges ensures that revenue will be collected even if customers choose to decrease their consumption or pursue a distributed generation alternative. For example, from FY 2023 through FY 2051, PREPA's load forecast shows a nearly 32% decrease in load. Thus, collecting revenue through fixed charges will help mitigate cash flow risks, for example, due to a decrease in demand.[64]

(55) The Oversight Board opted to employ a combined fixed and volumetric charge approach to generate the Revenue Envelope. The Oversight Board estimated these charges for residential customers—GRS 112 (General) customers, specifically—to determine what combination of fixed and volumetric

Support Grid Reliability and Expand Clean Energy Access," *US Department of Energy*, April 20, 2023, https://www.energy.gov/lpo/articles/lpo-offers-first-conditional-commitment-virtual-power-plant-sunnovas-project-hestia?utm_medium=email&utm_source=govdelivery.

62 Celia Kuperszmid and Shannon Baker-Branstetter, "The Fees That Raise Your Electric Bill Even When You Use Less Energy," *Consumer Reports*, March 7, 2016, https://www.consumerreports.org/consumer-protection/fees-that-raise-your-electric-bill-even-when-you-use-less-energy/.

63 Blake Houghton *et al.*, "Solving the rate puzzle: The future of electricity rate design," *McKinsey & Company*, March 8, 2019, https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/solving-the-rate-puzzle-the-future-of-electricity-rate-design.

64 *Revenue Envelope and Legacy Charge Model.xlsx*, "Load" tab.

charges, on top of PREPA's 2022 Fiscal Plan rates, would yield a maximum monthly electricity bill of $120 (i.e., equal to the 6% SOW affordability constraint).

(56) When setting the appropriate fixed and volumetric charges to generate the Revenue Envelope while staying within the 6% SOW affordability constraint, the Oversight Board first considered how much electricity the typical residential customer would consume per month (i.e., volumetric consumption) in FY 2024. Volumetric consumption for residential customers was estimated using annual median electricity cost in 2021 and the mean rate PREPA charged said customers in the same year.[65] I find it appropriate to use an annual median electricity spend (in dollars) and an annual mean rate (in cents per kWh) to perform this calculation, because (among other reasons) there are relatively few extreme outliers in terms of spend.[66] Accordingly, the median monthly volumetric consumption for residential customers in 2024 was estimated to be 425 kWh using this methodology.[67]

(57) For reasons noted above, the Oversight Board elected to prioritize fixed charges to generate the Revenue Envelope. As an initial step, the maximum fixed charge that could generate the Revenue Envelope while staying within the affordability constraint of residential GRS 112 (General) customers was $23.19.[68] This set the upper bound of what the fixed charge could reasonably be for this customer class. The Oversight Board decided to propose a $21 fixed charge, presumably to allow the opportunity to apply volumetric charges. Accordingly, since the monthly fixed charge in the 2022 Fiscal Plan was $4 for this customer class, the total monthly fixed charge for residential customers would be the sum of $4 and $21, or $25.[69]

(58) Data from over 2,500 electric utilities in the US were used to analyze fixed charges levied on residential customers and to compare those fixed charges with the proposed total fixed charge of $25 for PREPA's residential GRS 112 (General) customers.[70] The $25 total fixed charge falls well within the range of maximum fixed charges levied by other US utilities.[71]

65 "kWh Consumption.xlsx", (FOMB_PREPA 00022591).

66 Electricity consumption does not show the same degree of right-tail dispersion as incomes.

67 "kWh Consumption.xlsx", (FOMB_PREPA 00022591). I note that the 2024 monthly median consumption as calculated is 430 kWh. However, Brattle elected to use 425 kWh due in part because the load forecast data for 2021-2024 in the 2022 Fiscal Plan only accounted for energy efficiency effects from residential lighting and no other sources such as air conditioning, for example. As such, it is possible that load will be lower than forecast because of this omission. Brattle accordingly reduced its 2024 median monthly volumetric consumption to account for this.

68 *Revenue Envelope and Legacy Charge Model.xlsx*, "Affordability" tab. This maximum fixed charge is calculated by relying on the 2022 Fiscal Plan rates, estimated median volumetric consumption for residential customers in 2024, estimated median household income, and the 6% SOW affordability constraint.

69 "Fixed Charge Analysis.xlsx", "PREPA Fixed Charge" tab and *Revenue Envelope and Legacy Charge Model.xlsx,* "Affordability" tab.

70 "Fixed Charge Analysis.xlsx", "Residential" tab.

71 Approximately 20% of US utilities had a maximum fixed charge higher than $25. "Fixed Charge Analysis.xlsx", "Summary" and "Residential" tabs.

(59) I have reviewed this analysis and concur that the proposed fixed charge falls in the range of plausible fixed charges applied by other US utilities to residential customers. Moreover, it adheres to the 6% SOW affordability constraint, appropriately emphasizes fixed versus volumetric charges, and allows for a non-zero volumetric charge. This type of rate structure is common in US utility ratemaking.

(60) The Oversight Board also considered the fairness of charging such a fixed charge to its lower-income residential customers who may be unable to afford higher rates. To ensure these customers were not unduly burdened by an increase in their electricity bills, the Oversight Board excluded certain residential customer classes from paying the proposed $21 fixed charge.[72]

(61) The Oversight Board then scaled the fixed charge of other customer classes proportionally based on the change in fixed charges for GRS 112 (General) customers from the $4 fixed charge proposed in the 2022 Fiscal to the $21 fixed charge.

(62) The remaining revenue required to reach the 6% SOW for residential GRS 112 (General) customers was then obtained through a volumetric charge. The 2022 Fiscal Plan included inclining block rates (i.e., a tiered volumetric charge) for residential customers based on consumption; the Oversight Board also adopted such an approach for the volumetric portion of the Legacy Charge. Inclining block rates help balance the burden of electricity costs between low-income households, which typically use less electricity, and high-income households, which generally consume more electricity. Indeed, inclining block rates are "the most common residential rate form globally."[73] In my opinion, this general approach, and the manner in which it was implemented, was appropriate and reflected standard industry practice.

(63) In adopting inclining block rates, the Oversight Board created two rates, which I shall refer to as the Low Block Rate and the High Block Rate. The Low Block Rate would be charged to customers who consume up to 500 kWh per month while the High Block Rate would be charged to customers who consume over 500 kWh per month. Given the fixed charge of $21 that was previously determined, Brattle calculated a proposed Low Block Rate of 0.75 cents per kWh to arrive at the maximum monthly electricity bill of $120.[74]

(64) In the utility sector, it is common for the differences in block rates to be sizeable, typically multiples of each other. A study regarding time of use ("TOU") rates observed that the ratio of high rate to low

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72 See Disclosure Statement, Footnote 2 of Exhibit P. The residential customer classes which were excluded from the fixed charge are: RH3, LRS, RFR and GRS 112 (Subsidy-eligible).

73 Jim Lazar, "Bills and Rates: Implementing the three principles of smart rate design," *American Public Power Association*, August 22, 2019.

74 *Revenue Envelope and Legacy Charge Model.xlsx*, "Affordability" tab. Brattle calculated the Low Block Rate that was required to reach the maximum monthly electricity bill of $120 for a typical PREPA residential customer given the estimated monthly bill per the 2022 Fiscal Plan rates, an average consumption of 425 kWh per month, and the Legacy Charge fixed fee of $21. See Table 4 below for a breakdown of PREPA's rates under the 2022 Fiscal Plan for a typical Puerto Rico residential GRS 112 (General) customer.

rate for approximately 60% of utilities studied ranged from two-to-one to twelve-to-one, where the median multiple was 2.7.[75] While the volumetric charges proposed in the Revenue Envelope Model are not TOU rates, this study is still informative in suggesting the typical ratio between high and low rates in a two-rate block structure. Brattle elected to use a multiplier of four, which seems appropriate. Accordingly, the proposed High Block Rate for residential GRS 112 (General) customers is 3 cents per kWh, equal to four times the Low Block Rate of 0.75 cents per kWh. The Oversight Board then estimated the Low Block Rates and High Block Rates for non-residential customer classes using a similar approach as with the fixed charge, but in this instance it also incorporated each customer class's relative price elasticity of demand.

(65) Using a multiplier of four, as described above, shifts some of the Legacy Charge burden to higher-income customers who consume more electricity, in an effort to protect PREPA's more vulnerable customers. However, a larger High Block Rate also may incentivize these same customers to reduce consumption or turn to distributed generation alternatives, due to the price elasticity of demand, as discussed previously. Again, use of a high multiplier is a standard practice in the utility sector, while fewer volumetric tiers appear to yield better results.[76] The volumetric charges for the non-residential customer classes were based on affordability and elasticity considerations relative to High Block Rate of GRS 112 (General) residential customers.[77] Finally, to ensure PREPA's most vulnerable customers were protected from undue hardship, the Oversight Board exercised its judgment to exclude certain customer classes and those with annual incomes below a certain threshold (i.e., $20,000) from having to pay the fixed charge.[78] These same customers were also exempted from paying Low Block Rate and, if they consumed more than 500 kWh in a month, would pay 1.5 cents per kWh instead of the full 3 cents per kWh.

(66) **Table 4** below provides a breakdown of PREPA's current rate structure per the 2022 Fiscal Plan and the Revenue Envelope Model's proposed Legacy Charge rates discussed above for the residential GRS 112 (General) customer class.

[75] Ryan Hledick *et al.*, "Status of Residential Time-of-Use Rates in the US," *Public Utilities Fortnightly*, November 1, 2018, Figure 3. I also note that the utilities referenced in this analysis were those that had only two rate blocks.

[76] Ahmad Faruqui *et al.*, "The Paradox of Inclining Block Rates," *Public Utilities Fortnightly* (April 2015), (FOMB_PREPA 00022386-399).

[77] Disclosure Statement, Exhibit P.

[78] See Footnote 2 in Exhibit P of the Disclosure Statement and *Revenue Envelope and Legacy Charge Model.xlsx*, "Affordability" tab.

Table 4: PREPA electricity rate components for residential GRS 112 (General) customers[79]

PREPA residential GRS 112 (General) electricity rate components	2022 Fiscal Plan rates ($)	Revenue Envelope rates ($)
Median monthly household income	$2,000	$2,000
Median monthly residential volumetric consumption (kWh)	425	425
Expected 2022 Fiscal Plan charges		
Customer charge (fixed charge)	$ 4.00	$ 4.00
Per kWh, <= 425 kWh per month	$ 0.0494	$ 0.0494
Per kWh, > 425 kWh per month	$ 0.0556	$ 0.0556
Fuel & purchased power	$ 0.1224	$ 0.1224
Contributions in lieu of taxes	$ 0.0071	$ 0.0071
Subsidies	$ 0.0155	$ 0.0155
ERS pension projections	$ 0.0240	$ 0.0240
Total bill (excluding debt repayment)	$ 96.81	$ 96.81
Revenue Envelope Legacy Charge adders		
Fixed Charge adder	$ 0.00	$21.00
Per kWh, <= 500 kWh per month (Low Block Rate)	$ 0.00	$ 0.0075
Per kWh, > 500 kWh per month (High Block Rate)	$ 0.00	$ 0.0300
Total bill impact of Revenue Envelope adders	$ 0.00	$ 24.19
Total monthly bill	**$ 96.81**	**$ 121.00**
Total Fixed Charge	$ 4.00	$ 25.00
Total Volumetric Charge	$ 92.81	$ 96.00
SOW	**4.84%**	**6.05%**

(67) The Revenue Envelope Model uses the load forecast from the 2022 Fiscal Plan as an input alongside the price demand of elasticity estimates, fixed charges, and volumetric charges discussed above to estimate the Revenue Envelope over a 28-year period. Importantly, this incremental revenue is derived while staying within the 6% SOW affordability constraint, also discussed previously.

(68) After applying the proposed fixed and volumetric Legacy Charge to PREPA's load forecasts and accounting for the price elasticity of demand, the net present value ("NPV") of the upper bound of incremental revenue estimated by the Revenue Envelope Model is $6.383 billion (i.e., the Revenue Envelope).[80] This revenue represents the hypothetical maximum revenue which could be generated in addition to the revenue requirements defined in the 2022 Fiscal Plan and according to the aforementioned affordability and price elasticity of demand limitations.

[79] The price elasticities of demand for electricity from commercial customers is also applied for the government and municipal customers. See "LT Elasticity workbook.xlsx", (FOMB_PREPA 00022590); *Revenue Envelope and Legacy Charge Model.xlsx*, "RE_Inputs" tab.

[80] The NPV is calculated by discounting the future cash flows back to 2024 using a 6% discount rate. The discount rate is based on the discount rate of the New Bonds. See *Revenue Envelope and Legacy Charge Model.xlsx*, "Revenues Available" tab; Plan of Adjustment, p. 43.

III.A.3. The Revenue Envelope Model appropriately reflects the need to allocate some of the Revenue Envelope to prudent current and future expenses which are not accounted for in PREPA's 2022 Fiscal Plan

(69) Article 2.8 of the Law 17-2019 of Puerto Rico sets forth several duties and responsibilities that PREPA must uphold, including *inter alia*: to provide power in a reliable, resilient, efficient, and affordable manner; guarantee that universal electric power service is provided; conduct its business with correct fiscal and operating practices; and ensure the continuity and reliability of the electrical service.[81]

(70) For PREPA to meet the duties and responsibilities listed above, it must put forward a Legacy Charge which is feasible across multiple societal and economic dimensions; which enables it to recover reasonably incurred costs; and which allows for future CapEx investments to ensure PREPA's continuing and improved operations. Accordingly, it would be unreasonable and irresponsible for PREPA to allocate the entirety of the Revenue Envelope for the repayment of debt. PREPA must allocate some of the Revenue Envelope for additional costs either not represented in the 2022 Fiscal Plan (CapEx) or that arise from the imposition of the Legacy Charge (Fixed Cost Underrecovery).

III.A.3.a. PREPA has historically underinvested in the CapEx required to ensure it is able to provide reliable service to its customers and continue operations

(71) Historically, PREPA has underinvested in capital improvements for T&D and generation.[82] Indeed, PREPA's underinvestment in capital improvements and resiliency measures has been evident for many years. The 2017 Final Resolution and Order from the Puerto Rico Energy Commission notes that political pressures not to increase rates often resulted in sacrificing capital investments in order for PREPA to remain solvent.[83] In fact, PREPA's CapEx budgets in each major area (generation and T&D) decreased year-over-year from FY 2010 to FY 2016.[84]

(72) The effects of PREPA's underinvestment in CapEx are demonstrated in part by PREPA's system reliability and unplanned outage statistics. PREPA's reliability metrics are significantly worse than those of comparable utilities. For example, in calendar year 2020, PREPA's SAIDI was 21 hours, while for peer groups it was 2 hours.[85] PREPA customers also experienced nearly eight times more service interruptions than customers of the median US utility in 2020.[86] In a 2021 survey that

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81 Act No. 17 of April 11, 2019 of Puerto Rico at Article 2.8.

82 PREPA 2022 Fiscal Plan, p. 56.

83 Final Resolution and Order, January 10, 2017, CEPR-AP-2015-0001, In Re: Puerto Rico Electric Power Authority Rate Review.

84 Final Resolution and Order, January 10, 2017, CEPR-AP-2015-0001, In Re: Puerto Rico Electric Power Authority Rate Review.

85 PREPA 2022 Fiscal Plan, p. 21.

86 PREPA 2022 Fiscal Plan, p. 20.

evaluated utilities based on reliability, price, customer care, and more, PREPA came in last among 144 utilities.[87]

(73) In FY 2024 and FY 2025, $155 million and $178 million were budgeted, respectively, for non-federally funded T&D CapEx.[88] However, based on annual T&D CapEx spending of comparable utility companies in the southeastern US, PREPA's expected annual T&D CapEx was estimated to be $250 million per year beginning in FY 2023, adjusted for inflation thereafter ("Expected T&D CapEx").[89] This leaves a significant funding gap between the Expected T&D CapEx and budgeted T&D CapEx in the 2022 Fiscal Plan for these two years and beyond.

(74) The Revenue Envelope Model appropriately accounts for some of the shortfall between Expected T&D CapEx needs and the T&D CapEx requirements per the 2022 Fiscal Plan over the 28-year forecast period. Over the first ten years (FY 2024-2033), LUMA expected that $50 million more Federal Emergency Management Agency-related ("FEMA") T&D CapEx spending would be required.[90] This $50 million represents the *additional* cost-share funds required—above and beyond what was allocated in the 2022 Fiscal Plan—to allow PREPA to access some $1 billion per year in FEMA funding for ten years to improve system resiliency.[91] From FY 2034-2051, the annual T&D CapEx shortfall was instead calculated as the Expected T&D CapEx in each given year less the 2022 Fiscal Plan forecast amount.[92] **Table 7** in **Appendix C** shows these components of expected and budgeted T&D CapEx year-by-year.

(75) However, in the first ten years from FY 2024-2033, even after accounting for the additional $50 million in FEMA cost-share funds, there remains an Expected T&D CapEx shortfall. Appendix C provides additional detail, but the cumulative shortfall over the first ten years due to this continued deficit is approximately $365 million.[93] LUMA, the company which has assumed responsibility for

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[87] *News is my Business*, "Puerto Rico's electricity grid ranks last in utility performance survey," February 1, 2021, https://newsismybusiness.com/puerto-ricos-electricity-grid-ranks-last-in-utility-performance-survey/.

[88] LUMA Submission of Annual Budget, April 2, 2022 (FOMB_PREPA 00020540-21007), Exhibit 1 at Table 2-2.

[89] I have not been able to independently verify this yearly CapEx estimate, but I understand it was the result of an analysis performed by an independent consultant retained by the Oversight Board. See *Revenue Envelope and Legacy Charge Model.xlsx*, "Additional Capex Projection" tab.

[90] This $50 million appears to be the CapEx amount that PREPA must provide to secure FEMA funding. See LUMA letter to Proskauer re CapEx (February 7, 2023) (FOMB_PREPA 00023701-704), pp. 1-2.

[91] PREPA 2022 Fiscal Plan, p. 66, *Revenue Envelope and Legacy Charge Model.xlsx*, "Additional Capex Projection" tab and LUMA letter to Proskauer re CapEx (February 7, 2023) (FOMB_PREPA 00023701-704), pp. 1-2.

[92] The 2022 Fiscal Plan amounts for FY 2026-2051 are based on the LUMA's FY 2025 budgeted non-federal T&D CapEx increased by inflation per the 2022 Fiscal Plan inflation assumptions. See LUMA Submission of Annual Budget, April 2, 2022 (FOMB_PREPA 00020540-21007), Exhibit 1.

[93] See *Revenue Envelope and Legacy Charge Model.xlsx*, "Additional Capex Projection" tab. The $365 million was calculated by first determining the difference between the Expected T&D CapEx and the T&D CapEx requirements per the 2022 Fiscal Plan. Then, the $50 million reserved for the cost-share to receive FEMA funding was subtracted from the difference. Over the 10 years, this amounts to $365 million.

operation of PREPA's T&D assets, claims that this $365 million is a significant risk.[94] I note that the Revenue Envelope Model seems not to account for this $365 million shortfall.

(76) Altogether, the Revenue Envelope Model estimates that $2.425 billion is the total, nominal T&D CapEx required by PREPA from FY 2024-2051, above and beyond what is called for in the 2022 Fiscal Plan.[95] In NPV terms, this potential T&D CapEx shortfall amounts to approximately $887 million, which itself does not include the $365 million identified by LUMA.[96] For PREPA to continue operations, modernize its generation and T&D assets, and improve its services to ratepayers, additional funds for CapEx may be required in future. The potential existence of a T&D CapEx shortfall suggests that designating additional revenue for the Legacy Charge could be imprudent.

(77) In the absence of sufficient capital investments in its facilities, PREPA's generation and T&D assets would continue to deteriorate. This would result in even less-reliable service and the inability for PREPA to provide efficient, reliable, and universal power to all those who desire it—but a few of PREPA's duties and responsibilities as a utility.[97] Thus, it is inconceivable that every dollar from the Revenue Envelope could be earmarked for debt repayment.

III.A.3.b. PREPA must also generate revenues to cover its fixed and variable costs

(78) The Revenue Envelope Model anticipates that PREPA will need to address Fixed Cost Underrecovery due to the effect of the price elasticity of demand (i.e., reduced consumption caused by the higher Legacy Charge rates). PREPA's variable costs will decline with a reduction in consumption, but PREPA's fixed costs would remain materially constant whether consumption increases or decreases. PREPA's fixed costs would then be spread over a smaller revenue base. With declining sales as a result of increased rates, PREPA would have less revenue available to pay for its fixed costs, including for example fixed operation and maintenance ("O&M") expenses. This necessitates a marginal increase in rates to cover the underrecovered portion of fixed costs and ultimately to meet PREPA's original revenue requirement as defined in the 2022 Fiscal Plan.

(79) The underrecovery of fixed costs applies to cost categories such as labor expenses, maintenance expenses, and pension costs, among others. I understand that Brattle estimated the percentages of these cost categories which are fixed based on judgment and industry experience. For example, 100% of pension-related costs were classified as fixed costs (i.e., these costs remain unchanged regardless of load). Taken in aggregate, over the 28-year period, the Revenue Envelope Model estimates that Fixed Cost Underrecovery will amount to a NPV of approximately $812 million.[98]

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94 LUMA letter to Proskauer re CapEx (February 7, 2023), (FOMB_PREPA 00023701-704), p. 1.

95 *Revenue Envelope and Legacy Charge Model.xlsx,* "Additional Capex Projection" tab. See sum of row 9.

96 *Revenue Envelope and Legacy Charge Model.xlsx,* "Revenues Available" tab. See row NPV in row 128.

97 Act No. 17 of April 11, 2019 of Puerto Rico at Article 2.8.

98 See "Revenues Available" tab in *Revenue Envelope and Legacy Charge Model.xlsx.*

(80) Should the portion of the Revenue Envelope intended for Fixed Cost Underrecovery instead be allocated as payment to PREPA's creditors, the results would be damaging for PREPA. Ultimately, PREPA would be unable to meet the revenue requirement for its fixed operating expenses which, among other effects, would cause further deterioration of generation and T&D systems that are already in need of repairs and updates. Moreover, if it did not account for the effect of Fixed Cost Underrecovery in the Revenue Envelope Model, PREPA would face another financial deficit and have to raise customer's rates above the Legacy Charge. This would push PREPA's customers' SOW above 6% and risk further customer defection from the grid, which in turn could feed back on itself in a classic utility death spiral.

III.A.4. The remainder of the Revenue Envelope after accounting for CapEx and Fixed Cost Underrecovery represents the estimated upper bound of revenues available for creditors

(81) If it were unable to meet the revenue requirements associated with its fixed costs or make overdue and necessary capital investments to modernize its system, PREPA would be at risk of no longer being able to operate. As such, devoting a higher portion of the Revenue Envelope to debt repayment could potentially lead to a higher risk of system failure, higher risk of failure in implementing the Legacy Charge, and higher risk that the Puerto Rico Energy Board ("PREB") would deny the request to approve the Legacy Charge.

(82) Accordingly, creditors might reasonably expect to receive the remaining Revenue Envelope *after* accounting for PREPA's need to cover current costs and future investments while ensuring that the higher rates imposed by the Legacy Charge are still affordable for PREPA's customers, especially its most vulnerable ones.

(83) **Table 5** below provides a high-level summary of how the Revenue Envelope Model derives the Legacy Charge Revenues available for debt repayment. Considering that Fixed Cost Underrecovery is actually a cost associated with imposing higher rates, this amount is first subtracted from the Revenue Envelope to arrive at the Net Revenue Envelope. The Expected CapEx must then be subtracted from the Net Revenue Envelope to arrive at the portion revenues reasonably available for debt repayment.

(84) Accordingly, based on the Revenue Envelope Model methodology, 2022 Fiscal Plan forecasts, and additional inputs, the NPV of the Legacy Charge Revenues is estimated to be $4.684 billion over the 2022 Fiscal Plan's 28-year forecast horizon.[99] The Legacy Charge Revenues represent 73.4% of the Revenue Envelope and 84.1% of the Net Revenue Envelope.

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[99] I note that the repayment period of the bonds to be issued for purposes of debt repayment ("New Bonds") will be 35-years. The Legacy Charge Model discussed in Section III.B extends the forecast period from 28 years to 35 years to account for this.

Table 5: Derivation of the Legacy Charge Revenues (NPV $ in millions)[100]

Component	Amount
Revenue Envelope	$ 6,383
less Fixed Cost Underrecovery	($ 812)
= Net Revenue Envelope	**$ 5,571**
less Expected T&D CapEx shortfall	($ 887)
= Legacy Charge Revenues	**$ 4,684**

III.B. The Legacy Charge Model builds upon the Revenue Envelope Model and appears likely to yield Legacy Charge rates by customer class which are just and reasonable

(85) As discussed above, the Revenue Envelope Model derived a set of rates for each customer class that generated NPV of the Revenue Envelope of $6.383 billion. The Legacy Charge Model now determines the set of Legacy Charge rates (by customer class) which will yield $4.684 billion (the Legacy Charge Revenue), the portion of the Revenue Envelope that will be used to service PREPA's outstanding debt.

(86) The Legacy Charge Model tailors the fixed and volumetric charges estimated in the Revenue Envelope Model in an effort to shift the burden of the Legacy Charge away from PREPA's most vulnerable customers. I note that the Legacy Charge Model's slightly modified fixed charge and volumetric charge rate design still generates the Legacy Charge Revenues available for debt repayment as determined in the Revenue Envelope Model.

III.B.1. The Oversight Board makes reasonable adjustments to the Fixed Charge and Volumetric Charge components of the Legacy Charge to account for socioeconomic status and other settlement agreements

(87) While the Revenue Envelope Model proposes a Legacy Charge proportional to the increase in the Residential GRS 112 (General) class for *all* other customer classes, the Legacy Charge Model tailors the Legacy Charge according to customer class.[101] This is based on the Oversight Board's determination to balance the burden across customer classes in an effort to account for affordability and elasticity concerns and to protect the most vulnerable classes.[102] The adjustments to the rate

[100] See "Revenues Available" tab in *Revenue Envelope and Legacy Charge Model.xlsx*. Amounts in Table 5 represent the NPV over a 28-year forecast period.

[101] The Revenue Envelope Model adjustments to volumetric charges for non-residential customers were not perfectly proportional due to the need to account for each customer class's respective price elasticity of demand.

[102] Disclosure Statement, Exhibit P, p. 7.

design of the Legacy Charge do not affect the magnitude of the Legacy Charge Revenues but rather aims to redistribute where the revenues for debt repayment will be obtained.

(88) In transitioning from the Revenue Envelope Model to the Legacy Charge Model, municipal revenue associated with the Revenue Envelope is subtracted and proportionally allocated among the other customer classes (i.e., residential, commercial, government, and industrial). I understand that PREPA foregoes collection of revenues from municipalities in exchange for not paying certain taxes (i.e., contributions in lieu of taxes, known as "CILT").

(89) The fixed and volumetric charges derived in the Revenue Envelope for residential GRS 112 (General) customers must be reduced to generate that portion of the Revenue Envelope designated for debt repayment (i.e., Legacy Charge Revenues). To do so, the Oversight Board reduced the $21 fixed charge for residential GRS 112 (General) customers by the share of Legacy Charge Revenues available (NPV of $4.7 billion) relative to the maximum incremental revenues of the Revenue Envelope (NPV of $6.4 billion).[103] This reduction resulted in a fixed charge of $16.[104] The Low Block Rate for residential GRS 112 (General) was then calculated in the same manner as in the Revenue Envelope Model. Given the previously discussed parameters and constraints, the Low Block Rate that would yield a $120 monthly electricity bill for residential GRS 112 (General) customers, alongside the revised $16 fixed charge, was determined to be 2.2 cents per kWh. The fixed and volumetric charges for non-residential customer classes were estimated in a similar fashion as in the Revenue Envelope Model.

(90) The fixed charge for all eligible residential customers and small commercial customers (GSS 211) was reduced further from $16 to $13 per guidance from the Oversight Board. This adjustment aims to protect PREPA's most vulnerable residential customers and the smallest commercial customers, who have consumption patterns similar to residential customers.[105] A higher fixed charge may have resulted in unfairly disproportionate SOWs for lower income customers. To offset the reduced fixed charges for residential and commercial GSS 211 customers, the volumetric charges are increased for non-residential customers to generate necessary Legacy Charge Revenues for debt repayment.[106] These adjustments seem appropriate to me to ensure the Legacy Charge is not unduly burdensome on those customers who can least afford it.

(91) Revenues required for the National settlement are then added to the Legacy Charge Revenues determined by the Revenue Envelope Model. This increases the required Legacy Charge Revenues to

[103] The $4.7 billion available for the Legacy Charge is 73.4% of the total Revenue Envelope revenues of $6.4 billion. See "Legacy Charge (1)" tab in *Revenue Envelope and Legacy Charge Model.xlsx*.

[104] 73.4% of $21 is $15.41. This is then rounded up to $16.

[105] Specifically, the GSS 211 Commercial customers. This customer class has the smallest monthly consumption of any of PREPA's Commercial customers. See "Commercial" tab in *Revenue Envelope and Legacy Charge Model.xlsx*.

[106] See "Legacy Charge (2)" tab in *Revenue Envelope and Legacy Charge Model.xlsx*.

an NPV of $4.8 billion.[107] Consequently, the High Block Rate volumetric charge for the "Other Classes" was increased to yield the necessary revenues for covering the National settlement as well as the issuance of the New Bonds.[108] **Table 6** below details the Legacy Charge for each customer class after making the series of adjustments outlined above to the rates previously determined in the Revenue Envelope Model. Note that instances where the Fixed Charge or Volumetric Charge field is "0.00" indicates that the associated fee or charge would not be collected (i.e., those residential and small commercial customers who are subsidized or exempt from the Legacy Charge).

[107] See Exhibit N of the Disclosure Statement, pp. 35 and 36. The Oversight Board settled with National, one of PREPA's creditors, and proposed paying National 20% of its claim. This, combined with Consummation Claims and Structural Fees results in a total payment to National of approximately $216 million. The NPV of this addition, added to the Legacy Charge Revenues originally derived from the Revenue Envelope Model, comes to a total of $4.8 billion needed for bond repayment.

[108] See "Legacy Charge (+N)" tab in *Revenue Envelope and Legacy Charge Model.xlsx*.

Table 6: Proposed Legacy Charge[109]

Customer class	Fixed Charge ($/month)	Volumetric Charge (Low Block Rate, cents/kWh)	Volumetric Charge (High Block Rate, cents/kWh)
Residential			
RH3, LRS, RFR	$ 0.00	0.00	1.50
GRS 111/112 (Subsidy-eligible)	$ 0.00	0.00	1.50
GRS 111/112 (General)	$ 13.00	0.75	3.00
Commercial			
GSS 211	$ 16.25	1.50	3.00
GSP 212	$ 800.00	1.45	1.45
GST 213	$1,800.00	0.97	0.97
Government			
GSS 211	$ 20.00	1.45	2.90
GSP 212	$ 800.00	1.45	1.45
GST 213	$1,800.00	0.97	0.97
Industrial			
GSS 311	$ 20.00	2.18	2.18
GSP 312	$ 800.00	2.18	2.18
GST 313	$ 1,800.00	1.45	1.45
TOU-T 363	$ 1,800.00	1.45	1.45
LIS 333	$ 1,800.00	1.45	1.45
TOU-T 963	$ 1,800.00	1.45	1.45

(92) Finally, the Legacy Charge Revenues forecast is extended from 28 years to 35 years to match the repayment period of the New Bonds, resulting in an additional seven years of payments. Ultimately, the Legacy Charge Revenues over 35-years are estimated to be at least $5.68 billion in NPV terms.[110]

[109] Note that Low Block Rate refers to the volumetric charge for consumption less than or equal to 500 kWh and High Block Rate refers to the volumetric charge for consumption greater than 500 kWh. See "Exhibit_POA" tab in *Revenue Envelope and Legacy Charge Model.xlsx.* As noted previously, the residential customer classes "RH3, LRS, RFR" and "GRS 111/112 (Subsidy-eligible)" are exempt from the fixed charge and Low Block Rate, and are charged 50% of the regular, GRS 111/112 (General) High Block Rate.

[110] I note that the Legacy Charge Model calculates the NPV of Legacy Charge Revenues to be $5.75 billion rather than $5.68 billion. See "Legacy Charge (+N)" tab in *Revenue Envelope and Legacy Charge Model.xlsx.* The Plan proposes to issue New Bonds (the Series A Bonds and Series B Bonds) having an aggregate original principal amount of approximately $5.68 billion. See Plan of Adjustment, p. 24 (definition of "New Bonds"). Going forward, when referencing the Legacy Charge Revenues, I shall refer to the $5.68 billion, since the calculated NPV of Legacy Charge Revenues sufficiently covers the original principal amount of the New Bonds.

III.C. The resulting Legacy Charge is consistent with the principles of just and reasonable rates

(93) Historically, the concept of "just and reasonable rates" has been left open to interpretation, oftentimes before legal or regulatory bodies.[111] The just and reasonable standard is typically informed by evidence and testimony submitted by stakeholders.[112] Nonetheless, just and reasonable rates have come to mean those which allow the utility to be compensated for prudently incurred costs and the opportunity to earn a return on and of reasonably invested capital.[113]

(94) In estimating the Legacy Charge, the Oversight Board faced several constraints to raise revenue for the New Bonds, including the poor status of PREPA's T&D and generation assets, customer affordability, price elasticity of demand, and the recovery of otherwise unaccounted for current and future costs (e.g., Fixed Cost Underrecovery and additional CapEx). Furthermore, among other considerations, the Legacy Charge aims to set PREPA on a course towards achieving its statutory mission, fiscal responsibility, and access to capital markets by repaying a portion of its outstanding debt.[114]

(95) When confronted with these constraints the Oversight Board made determinations based on either the use of reasonable economic methodologies, or the interests of PREPA, PREPA's customers, and its other stakeholders. Accordingly, the Legacy Charge attempts to sustain PREPA without losing PREPA's customers, to produce cash flow for PREPA's creditors.

(96) One way of determining whether utility rates are just and reasonable is to judge them against the "attributes of a sound rate structure" articulated by James C. Bonbright in a seminal work in the field of public utility ratemaking.[115] These attributes, which are intended to help regulators determine whether utility rates appropriately balance the interests of ratepayers with those of the utility company itself, are as follows:

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[111] Steve Isser, "Just and Reasonable: The Cornerstone of Energy Regulation," (working paper, *Energy Law and Economics*, 2015), p. 1; Kiera Zitelman and Jasmine McAdams, "The Role of State Utility Regulators in a Just and Reasonable Energy Transition," National Association of Regulatory Utility Commissioners (September 2021), p. 5.

[112] Kiera Zitelman and Jasmine McAdams, "The Role of State Utility Regulators in a Just and Reasonable Energy Transition," National Association of Regulatory Utility Commissioners (September 2021), p. 5.

[113] John Wolfram, "Utility Rates: Fair, Just and Reasonable," *Catalyst Consulting LLC* (2013), http://www.catalystcllc.com/articles/utility-rates-fair-just-and-reasonable/#:~:text=From%20the%20utility%20perspective%2C%20the,recover%20their%20prudently%2Dincurred%20costs.

[114] PREPA, as an instrumentality of the Commonwealth, is charged with certain duties and responsibilities including, "[t]o provide and allow electric power to be provided in a reliable, clean, efficient, resilient, and affordable manner thus contributing to the general well-being and sustainable development of the people of Puerto Rico." Act No. 17 of April 11, 2019 of Puerto Rico at Section 6(a).

[115] James C. Bonbright, *Principles of Public Utility Rates* (NY, Columbia University Press, 1961), p. 291.

- Rates should have the following practical attributes: simplicity, understandability, public acceptability, and feasibility of application.
- Rates should be free from controversies as to proper interpretation.
- Rates should effectively yield total revenue requirements under the fair return standard.
- Rates should provide revenue stability from year to year.
- Rates themselves should be stable, i.e., rates should experience minimal unexpected changes that are seriously adverse to existing customers.
- Rates should apportion the total cost of service fairly among different consumers.
- Rate relationships should avoid "undue discrimination."
- Rates should promote efficiency, discouraging wasteful use of energy while promoting all justified types and amounts of use.

(97) Although the Legacy Charge constitutes only one element in total charges to be paid by PREPA's customers, my review of the Revenue Envelope Model and the Legacy Charge Model revealed no violation of any of the Bonbright principles or indeed any divergence from practices generally applied in the field of utility ratemaking.

(98) In my opinion, the Legacy Charge and associated Legacy Charge Revenues are consistent with the concept of just and reasonable rates.

IV. The Legacy Charge methodology appropriately accounts for upside and downside risks

(99) Although the Legacy Charge methodology and the Legacy Charge Model determined from that methodology are subject to a variety of risks and uncertainties, the two most significant of those are load forecast risk and fuel price forecast risk. Although I accept PREPA's 2022 Fiscal Plan as given, I nonetheless consider each of these in turn below.

IV.A. The Legacy Charge's proposed mix of fixed and volumetric charges mitigates risks associated with the underlying load forecasts

(100) As with any forecast, the load forecasts incorporated in the Revenue Envelope Model and Legacy Charge Model are subject to uncertainty as actual conditions through time differ from those assumed in the model. The situation in which load is underestimated is not a significant source of financial risk, because greater load than has been modeled would lead to increased revenue and an enhanced ability to service and pay off PREPA's debt more quickly, generating value for the contingent value instrument ("CVI") to be distributed to PREPA's creditors under the Plan. Therefore, the primary risk I considered was the situation where PREPA's forecasts had overestimated load.

(101) The 2022 PREPA Fiscal Plan includes load forecasts, which indicate anticipated demand for electricity in future. I reviewed load forecasts from the FY 2017 Fiscal Plan model and the 2019 Integrated Resource Plan ("IRP")—encompassing fiscal years 2017-2022—against actual loads for those years.[116] The average load forecast during this time period was approximately 17,100 gigawatt-hours ("GWh"), while the average actual load was approximately 16,700 GWh, meaning on average the forecasts overestimated load by about 2%.[117] Based on my analysis, all else equal, overestimating load by 2% in each year of the 2022 Fiscal Plan forecast would result in a less than one percent decrease in Legacy Charge Revenues available to repay creditors.[118] These divergences are, in my opinion, well within the range typical of load and revenue forecasts in the industry.

(102) Given that the Revenue Envelope Model relies on load forecasts that incorporate assumptions regarding energy efficiency, distributed generation, and Act 17-2019 effects, the model is already anticipating many of the reasons load could decrease in future.[119] Importantly, the rate design of the

[116] "PREPA Fiscal Plan Financial Model (170428) DRAFT.xlsx", "Inputs", (FOMB_PREPA 00024665); IRP2019 - Ex 1.00 - Main Report REV2, June 7, 2019 (FOMB_PREPA 00024202) ("2019 IRP"), Exhibit 3-26; "PREPA Fiscal Plan Model v06.29.2022 vSHARE.xlsx", "Load", (FOMB_PREPA 00024561). This analysis did not use data from FY 2018, as Hurricanes Maria and Irma hit Puerto Rico that year, causing significantly lower load.

[117] Again, this analysis excluded 2018.

[118] See "2023.04.28 Bates White PREPA load forecast sensitivity analysis.xlsx," a Bates White spreadsheet analysis which by reference forms an integral part of this expert report.

[119] "PREPA Fiscal Plan Model v06.29.2022 vSHARE.xlsx", sheet "Load", (FOMB_PREPA 00024561).

Legacy Charge puts more emphasis on the Fixed Charge than Volumetric Charge. This, in part, insulates PREPA's creditors from the risk of receiving less debt repayment in a given year due to actual load falling short of forecast load.

(103) In my opinion, the Oversight Board's proposed split between the Legacy Charge's fixed and volumetric components is broadly consistent with approaches commonly applied in the industry in an effort to mitigate load forecast risk.

IV.B. PREPA's fuel price forecasts appear to rely on standard benchmarks and methodologies

(104) Fuel costs account for a majority of PREPA's annual revenue requirements. For example, in FY 2023 non-renewable fuel costs represented approximately 58% of PREPA's total revenue requirement.[120] Accordingly, the reliability of the forecasts used to estimate PREPA's fuel costs play an important role when determining the Revenue Envelope, though divergence between actual fuel costs in future years and those included in the forecast would not affect repayment of the New Bonds.

(105) I understand that PREPA has a history of underestimating fuel costs in its fuel price forecasts. Between FY 2018 to FY 2022, PREPA underestimated its annual fuel costs by an average of 41%.[121] I therefore reviewed PREPA's methodology and assumptions for its fuel price forecasts to determine the reasonableness of the price forecasts for the primary fuel types used to power PREPA's electricity generation plants. Per the 2022 Fiscal Plan, the four fuel types are natural gas, transported to Puerto Rico in the form of LNG; Bunker-C (also known as residual fuel oil, or "RFO") and Diesel fuel (D2) (both petroleum products); and coal.[122]

(106) Based on my review of the 2022 Fiscal Plan, it appears that PREPA relied on a fuel price forecast methodology developed by Siemens, which in turn was used to prepare PREPA's 2019 IRP.[123] Siemens identified the following sources as benchmarks for its forecasts of PREPA's four main fuel types: Henry Hub for natural gas, West Texas Intermediate ("WTI") for crude oil, its spring outlook for Illinois Basin coal for coal, and New York Harbor pricing (per contract terms for the oil powered Costa Sur Power Plant) for diesel and RFO.[124]

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[120] PREPA 2022 Fiscal Plan, Exhibit 63.

[121] Puerto Rico Electric Power Authority, *Puerto Rico Electric Power Authority Fiscal Plan*, April 28, 2017; Puerto Rico Electric Power Authority, *2019 Fiscal Plan for the Puerto Rico Electric Power Authority*, June 27, 2019; Puerto Rico Electric Power Authority, *2020 Fiscal Plan for the Puerto Rico Electric Power Authority*, June 29, 2020; Puerto Rico Electric Power Authority, *2021 Fiscal Plan for the Puerto Rico Electric Power Authority*, May 27, 2021; "PREPA Fiscal Plan Model v06.29.2022 vSHARE.xlsx", (FOMB_PREPA 00024561).

[122] PREPA 2022 Fiscal Plan, p. 156 and Exhibit 61.

[123] PREPA 2022 Fiscal Plan, p. 156.

[124] 2019 IRP, Section 7-2.

(107) I then compared each fuel price forecast in the 2022 Fiscal Plan against forecasts for the analogous fuel types from the 2022 US Energy Information Agency ("EIA") Annual Energy Outlook ("AEO"), which is a commonly referenced source for energy commodity price forecasts.[125] The full results of this comparison can be found in **Appendix C**. Generally, the comparison found that PREPA's forecasts were higher than the EIA's forecasts for LNG and coal, while PREPA's forecasts were typically lower than the EIA's forecasts for RFO and diesel.

(108) In the interest of conservatism, it is appropriate to err on the side of overestimating, rather than underestimating, PREPA's fuel price forecasts relative to the broad range of fuel price forecasts generally applied in the utility sector, including the EIA AEO. Underestimates may limit the amount of revenue available for the Legacy Charge. Given that natural gas was PREPA's most-used fuel in 2021, a slightly higher LNG price forecast is conservative. Should actual fuel prices be lower than forecasts in any given fiscal year, PREPA's fuel cost recovery would be lower as well. Conversely, should actual fuel prices be higher than forecasts, fuel prices would increase and ratepayers would bear that cost, potentially affecting affordability. I note here that fuel price risk may decline over time as PREPA transitions away from fossil fuels and toward more renewable energy procured through Power Purchase and Operating Agreements ("PPOAs").

(109) As a further check, I compared the fuel price forecasts in the 2022 Fiscal Plan with those in the 2023 EIA AEO. I understand that this is not an apples-to-apples comparison, since the two sets of forecasts are not contemporaneous, but I nonetheless believe this is a useful comparison. Unsurprisingly, PREPA's forecasts vary more relative to the 2023 AEO than to the 2022 AEO, since more time has elapsed between the two forecasts and global energy markets have, since mid-2022, undergone significant disruption due to the armed conflict in Ukraine and associated events.[126] In my opinion, the energy market disruption reflected in the 2023 AEO is unlikely to persist in the mid- to long-term because many relevant factors (e.g., destruction of the Nord Stream natural gas pipeline) are one-time events. This in turn suggests that energy markets may revert over time to trends better reflected in the 2022 AEO than in the 2023 AEO. Considered in aggregate, PREPA's fuel price forecasts appear reasonable.

(110) I also considered any potential concerns related to PREPA's fuel price modeling approach change from PROMOD to Aurora. PROMOD and Aurora are two power sector modeling tools which are commonly used in the electric utility sector. PREPA noted that declining fuel prices and its new modeling approach were the principal factors behind its more than 50% decrease in forecast fuel

[125] I also note that the 2022 Fiscal Plan forecasts are from March 2022—which is when the 2022 AEO was released—and that they include the effective PREPA contract adders. US Energy Information Administration, *Annual Energy Outlook 2022*, March 16, 2022 ("2022 Annual Energy Outlook").

[126] Simon Flowers, "How the Russia-Ukraine war is changing energy markets," *Wood Mackenzie News*, February 23, 2023, https://www.woodmac.com/news/the-edge/how-the-russia-ukraine-war-is-changing-energy-markets/.

prices in FY 2024.[127] According to the 2022 Fiscal Plan, Aurora assumes "an optimal economic dispatch, without the capacity to consider transmission constraints," which accounts for much of the reduction in fuel costs between FY 2023 and FY 2024.[128] In my experience, however, both models (PROMOD and Aurora) produce plausible market projections and are considered reliable modeling tools.

(111) In sum, it is my opinion that PREPA's fuel price forecasting methodology is reasonable and appropriate in the context within which it is used. In my opinion, PREPA's current modeling approach is broadly consistent with approaches commonly applied in the industry.

IV.C. The structure of the New Bonds provides assurances to PREPA's creditors and protects PREPA's customers from additional Legacy Charge rate increases except under extreme circumstances

(112) From the perspective of PREPA's creditors, the structure of the New Bonds provides a cushion with regard to raising revenue in the coming years. The Series B bonds have a maturity of 50 years but are expected to be paid off in 35 years.[129]

(113) Should actual revenues exceed projected revenues, the bonds will be paid sooner than the projected 35 years.[130] In this case, the excess cash flows generated from the Legacy Charge will then go to payment of the CVI until 2058. Should actual revenues be lower than projected, the Series B bonds will continue to be paid for the 50-year period.[131] If they are not paid in full by 2073, the principal and any accrued interest will need to be paid, but no new interest will accrue. Additionally, there will be no default if PREPA is unable to pay in full by 2073.[132]

(114) Even if revenues are overestimated or underestimated, creditors are protected by various bond repayment mechanisms, such as a covenant to raise rates to cover interest on the New Bonds.[133] These mechanisms provide additional protection against any risk associated with incorrect load or fuel cost forecasts, among other sources of risk and uncertainty. The structure of the Series B bonds protects PREPA, in part, from default, balances affordability by limiting the possibility of future additional Legacy-Charge-related rate increases on PREPA's customers, and includes multiple conditions to ensure creditors are reimbursed.

127 PREPA 2022 Fiscal Plan, p. 141.
128 PREPA 2022 Fiscal Plan, Table 14, p. 162.
129 Disclosure Statement, p. 36.
130 Plan of Adjustment, p. 43.
131 Plan of Adjustment, p. 43.
132 Plan of Adjustment, p. 48.
133 Disclosure Statement, pp. 5-6.

Glenn R. George

4/28/23

Glenn R. George

Date

Appendix A. Curriculum Vitae of Glenn R. George, MBA, PE, PhD

Business Address

Bates White Economic Consulting
2001 K Street, Northwest, North Building, Suite 500
Washington, District of Columbia 20006
United States of America
Telephone (main) +1.202.408.6110

Education

Harvard University, Graduate School of Arts and Sciences — Cambridge, MA
Doctor of Philosophy, Public Policy — 1995
Primary Dissertation Advisor Prof. F. M. Scherer (microeconomist)
Coursework under US Supreme Court Justice emeritus Stephen Breyer

Bettis Atomic Power Laboratory, Bettis Reactor Engineering School — Pittsburgh, PA
Certificate in Nuclear Engineering — 1988

Cornell University, Johnson Graduate School of Management — Ithaca, NY
Master of Business Administration, with Distinction — 1986

Cornell University, College of Engineering, — Ithaca, NY
Bachelor of Science, with Distinction, Mechanical Engineering — 1985

Professional Experience

Bates White Economic Consulting — Washington, DC
Partner, Energy Practice — 2010-2012; 2018-present

Independent Economic Expert — Haddonfield, NJ
Including acting Founding Partner, Innogy Consulting USA — 2017-2018

NERA Economic Consulting — Washington, DC
Managing Director, Energy Practice — 2015-2017
Vice President, Energy Practice, and Registered Representative, MMC Securities Corp. 2006-2010

KPMG LLP — Philadelphia, PA
Principal (partner), Dispute Advisory Services — 2012-2015

Nomura Securities International, Inc. — New York, NY
Director and Co-Head, International Energy Capital Markets Group — 2004-2006

PA Consulting Group, Inc.	Plainsboro, NJ
Senior Engagement Manager	2001-2004
energyLeader.com	Philadelphia, PA
Senior VP, Design	2000-2001
PricewaterhouseCoopers Consulting	Philadelphia, PA
Principal Consultant and Engagement Manager, Utility M&A Practice	1998-2000
Hagler Bailly Consulting	Philadelphia, PA
Managing Consultant and Engagement Manager	1995-1998
Defense Nuclear Facilities Safety Board	Washington, DC
Project Officer and Program Manager	1991-1995
Office of Naval Reactors	Washington, DC
Naval Officer, Nuclear Engineer, and Special Assistant to the Deputy Director	1986-1991

Expert Testimony and Other Dispute-Related Experience

Expert witness (2020-present) on behalf of Nigeria in *The Ministry of Petroleum Resources of the Federal Republic of Nigeria v. Process and Industrial Developments Ltd*., a very prominent, USD 11 billion litigation matter pending in the High Court of England and Wales. The case involves Nigeria's effort to overturn an international arbitration award related to damages from an abandoned and allegedly fraudulent natural gas processing facility project in Nigeria. Initial expert reports were exchanged in June 2022, a joint memorandum was submitted to the court in September 2022, and reply reports were exchanged in October 2022. Dr. George testified at trial in the High Court in February 2023. A decision is anticipated in 2023.

Expert testimony (2021-present) on behalf of claimant in *Mesa SpA v. Número Um-Reparação de automóveis SA and TOPCHALLENGE SGPS, S.A.*, an international arbitration matter under ICC rules. Claimant alleges violation of terms (including regarding non-competition and ownership of intellectual property) of the master franchise agreement for MIDAS automobile repair shops in Portugal. Dr. George's testimony quantifies claimed damages and responds to counterclaim damages. He testified at the arbitration hearing in November 2022 in Paris. A decision is anticipated in 2023.

Expert testimony (2020-present) on behalf of claimant in *Elevolution–Engenharia, S.A. v. The Islamic Republic of Mauritania*, an international arbitration matter. The case involves a canceled contract to rebuild a highway in Mauritania using seashells as the source of aggregate material. Due to the unavailability of seashells, the claimant requested use of standard aggregate; the respondent denied the request, canceled the contract, and awarded the project to an alternate contractor. The replacement contractor proceeded to complete the highway using standard aggregate. Dr. George quantified the damages suffered by the claimant as the discounted sum of lost profits from the

project, and rejected as economically unfounded the counterclaim damages asserted by respondent. He testified at the arbitration hearing in March 2022 in Paris. A decision is anticipated in 2023.

Expert testimony (2020-2023) on behalf of respondent in *Westwater Resources, Inc. v. Republic of Türkiye* (ICSID Case No. ARB/18/46). Claimant, a US-based mining company, alleged that, in rescinding seven uranium exploration and operating licenses for the Temrezli, Sefaatli, and Sorgun uranium mining projects, the government of Türkiye caused financial damages to Westwater pursuant to the Türkiye-US Bilateral Investment Treaty of 1985. Analysis examined the global market for uranium ore, including supply (from mines through the complex value chain for uranium processing) and demand (primarily from nuclear power plants), together with the facts and circumstances surrounding the specific mining projects in question, including whether the facility could have been financed and completed in light of claimant's weak financial position. Expert reports concluded that no damages were owed. Dr. George delivered oral testimony before the arbitral tribunal in August 2021. In a March 2023 award almost wholly in favor of the Türkiye, the tribunal cited Dr. George's testimony multiple times. The tribunal ultimately rejected Westwater's claim based on lost profits, and found that Westwater was entitled to be compensated only for "investment costs," which Türkiye acknowledged must be paid by virtue of the license rescissions irrespective of Westwater's prospects of bringing the projects to a successful conclusion.

Expert testimony (2019-present) on behalf of defendants in *Eddystone Rail Company, LLC v. Bridger Logistics, et al.*, an ongoing litigation matter in the US Court for the Eastern District of Pennsylvania. The case involves a contract dispute regarding an oil transloading facility in Eddystone, Pennsylvania. The facility, which was built, owned, and operated by plaintiff, was used as part of defendants' logistics chain, whereby crude oil from North Dakota was ultimately shipped to a refinery on the Delaware River. Plaintiff alleges that, among other wrongful actions, defendants abandoned the business of transporting oil when prices dropped in 2015-2016, effectively stranding plaintiff's $170 million investment in the transloading facility. Analysis addressed defendants' counterclaim that, but for construction delays and various inadequacies in the design and operation of the transloading facility, significantly more oil could have been shipped to the refinery and additional profits made from use of the facility while oil prices remained favorable. Expert report quantified those counterclaim damages in a series of five counterfactual scenarios, opining that the counterclaims might total as much as $70 million. Dr. George testified at trial regarding remaining heads of counterclaim damages in December 2022. A decision is anticipated in 2023.

Expert testimony (2019-2021) on behalf of Ontario Power Generation (OPG), one of the largest utility companies in North America, in a rate case and prudence review before the Ontario Energy Board (OEB) regarding the $10 billion cost to refurbish the Darlington Nuclear Generating Station near Toronto. At issue are the significant delay and nearly 400% cost overrun associated with the heavy water (D2O) storage facility project at Darlington. Testimony concluded that an analysis performed prior to construction would have estimated the cost at close to the amount

actually spent. Dr. George responded to written interrogatories in spring 2021 and delivered oral testimony before the OEB in August 2021. OPG received a favorable rate order from the OEB in November 2021.

Expert testimony (2018-present) on behalf of defense in *Desert Sunlight 250, LLC, and Desert Sunlight 300, LLC v. United States*, an ongoing matter in the US Court of Federal Claims (COFC 17-1826C). Plaintiffs seek nearly $60 million in damages stemming from their reduced payments pursuant to Section 1603 of the American Recovery and Reinvestment Act of 2009, which provided for a cash grant in lieu of tax credit for certain qualified investments in renewable energy property, including solar power projects. Dr. George's expert reports address whether plaintiffs' claimed cost basis (in excess of $2 billion) properly excludes any intangible, grant-ineligible property and whether the US Treasury should award any additional amounts. Testimony presents an analysis of intangible property included in plaintiffs' claimed basis, including above-market power purchase agreements and a US Department of Energy loan guarantee. The case settled on terms favorable to the Government in 2022.

Expert testimony (2018-2021) on behalf of defense in *Silver State Power South, LLC v. United States*, an ongoing matter in the US Court of Federal Claims (COFC 18-266T). Plaintiff seeks nearly $140 million in damages stemming from its reduced payment pursuant to Section 1603 of the American Recovery and Reinvestment Act of 2009, which provided for a cash grant in lieu of tax credit for certain qualified investments in renewable energy property, including solar power projects. Dr. George's expert reports address whether plaintiff's claimed cost basis (nearly $1 billion) properly excludes any intangible, grant-ineligible property and whether the US Treasury should award any additional amounts. Testimony presents an analysis of intangible property included in plaintiff's claimed basis, including an above-market power purchase agreement and an indemnity provision. The case settled on terms favorable to the Government in 2022.

Expert witness and analytical support (2017-2018) on behalf of Uganda in *Democratic Republic of the Congo v. Uganda*, at the International Court of Justice at The Hague. In that case, which was filed in 1999, Dr. George developed an exhaustive critique of the damages methodology employed by the DRC's quantum experts which purported to value various heads of damages, totaling $11.3 billion, including mineral resource assets, energy infrastructure, and lives lost as a result of the conduct of Ugandan soldiers. In part due to his work, the ICJ in early 2022 awarded the DRC damages in the amount of $325 million.

Expert witness on behalf of applicant before the Regulatory Commission of Alaska (2015–2016). At issue in the rate case was the applicability of the Operating Ratio method of rate regulation as an alternative, for utilities possessing a high capital turnover ratio, to the Rate Base/Rate of Return methodology. Recommended an improvement to the Operating Ratio method to make it applicable to a broader array of utility rate cases. The case settled.

Expert testimony on behalf of defense in *HEAL Utah, et al. v. Kane County Water Conservancy District, et al.*, in Utah District Court for the 7th District of Utah (No. 120700009). Plaintiffs sought relief, which would have been tantamount to a government expropriation of nuclear power

plant development rights associated with a tract of land. Addressed market demand for future power plant output in light of public policies favoring nuclear technology despite its complexity and political sensitivity. The Court rejected the claim *in toto* and accepted the testimony given on behalf of the defendant.

Publications

"Goldilocks and the Grid: Creating 'No Regrets' State Policies and Regulations for Electric Vehicles." Washington, DC: Bates White Economic Consulting, May 2019.

"How Can Utilities Prepare for the Approaching Electric Vehicle Boom?" *Utility Dive*, July 20, 2018.

"Many US utilities are in denial: (Opinion) Utilities need to start thinking about the local-level model in a very different way—and looking to Europe would be a good start." *Recharge*, June 19, 2018.

"Success Strategies in New Japanese Electric Power Market" (with Hans-Martin Ihle). *Public Utilities Fortnightly* 154, no. 11 (November 2016), pp. 34-39.

"Getting Ready for Competition in Japan." *Public Utilities Fortnightly*, 154, no. 10 (October 2016), pp. 38-47.

"Electricity Market Reform in Japan: Bumpy Road Ahead" (with Hans-Martin Ihle and Miura Wataru) *Public Utilities Fortnightly* 154, no. 8 (August 2016), pp. 18-25.

Recent Presentations and Panels

"Economics of Small Modular Reactors (SMRs) and Advanced Reactors (ARs): Can They Compete?" Speaker, Applications for SMRs and Advanced Reactors to Promote Clean Growth, conference sponsored by Strategic Communications, Abu Dhabi, February 5, 2020.

"Future Directions for the Defense Nuclear Facilities Safety Board: Board Basics." Panelist, American Nuclear Society Winter Meeting & Expo, Washington, DC, November 19, 2019.

"Goldilocks and the Grid: Creating 'No Regrets' State Policies and Regulations for Electric Vehicles (EVs)." Speaker, Advanced Workshop in Regulation & Competition, Center for Research in Regulated Industries, Rutgers University, Newark, NJ, November 15, 2019.

"Proving and Determining Damages in International Arbitration: Methods, Trends and Best Practices, Panelist," webinar sponsored by The Knowledge Group, October 24, 2019.

"Do Electric Vehicles Go Faster Than a Golf Cart? The Real Story of EVs in the Southeast," Panelist, SEARUC 2019 Conference, Gulf Shores, AL, June 3, 2019.

"Transitioning to a Greener Grid," Panelist, Ballard Spahr's 7th Annual Green Infrastructure Conference, Philadelphia, PA, November 13, 2018.

"Public Policy: Focus on Puerto Rico's Electric Power Situation." Discussant. Rutgers University Center for Research in Regulated Industries, 36th Annual Eastern Conference, Annapolis MD, June 1, 2017.

"Investment Disputes Year in Review." Panelist, Global Arbitration Review Live BITs Conference, Covington and Burling, Washington, DC, May 23, 2017.

NERA Summit on Electric Power Market Reform. Panelist, Tokyo, November 2, 2016.

"Effect of Regulation on Nuclear Power Plant Construction Risk Management." Keynote address, IAEA Meeting on Construction Risk, Vienna, Austria, September 7, 2016.

"Reviving the Operating Ratio Method for Utility Ratemaking." Presenter (with Joel E. Simkins). Center for Research in Regulated Industries, Newark, NJ, December 2015.

Japan Energy Forum. Discussion leader, KPMG and Bracewell & Giuliani, New York, June 2, 2014.

"Electric Power Capacity Market Issues." Discussant. Center for Research in Regulated Industries, Eastern Conference, Shawnee, PA, May 15, 2014.

"Can Nuclear Compete?" Panelist, Nuclear Infrastructure Council, Special Summit on New Nuclear Energy, Washington, DC, June 19, 2012.

"Smartgrid Ratemaking: One Approach." Presenter. Center for Research in Regulated Industries, Advanced Workshop in Regulation and Competition, Rutgers Business School, Newark, NJ, January 13, 2012. Eastern Conference, Shawnee, PA, May 17, 2012.

"View from the Financial Community." Panelist. US Department of Commerce, International Trade Administration, Civil Nuclear Finance Forum, Washington, DC, April 26, 2012.

"Nuconomics: SMRs to the Rescue? Impact on New Nuclear of Cheap Natural Gas and Carbon, Renewables, Fukushima, and the End of US DOE Loan Guarantees." Presenter. American Nuclear Society Small Modular Reactor Conference, Washington, DC, November 1, 2011.

Additional Information

Member, American Economic Association.
FINRA Series 7 and Series 63 registrations (inactive).
Registered Professional Mechanical Engineer in the District of Columbia (license # 9803).

Appendix B. Documents considered or relied upon

B.1. Documents and data with Bates numbers

- "kWh Consumption.xlsx" (FOMB_PREPA 00022591).
- "LT Elasticity workbook.xlsx" (FOMB_PREPA 00022590).
- "PREPA Fiscal Plan Financial Model (170428) DRAFT.xlsx", (FOMB_PREPA 00024665).
- "PREPA Fiscal Plan Model v06.29.2022 vSHARE.xlsx", (FOMB_PREPA 00024561).
- Buchsbaum, Jesse. "Long-run price elasticities and mechanisms: Empirical evidence from residential electricity customers." PhD job market paper, University of California, Berkeley, October 2022, (FOMB_PREPA 00022518-89).
- Burke, Paul J. and Ashani Abayasekara. "The price elasticity of electricity demand in the United States: A three-dimensional analysis." *The Energy Journal* 39(2) (2018), (FOMB_PREPA 00022494-517).
- Faruqui, Ahmad, Ryan Hledik, and Wade Davis. "The Paradox of Inclining Block Rates." *Public Utilities Fortnightly* (April 2015), (FOMB_PREPA 00022386-399).
- FOMB - Certified PREPA 2022 Fiscal Plan. June 28, 2022 (FOMB_PREPA 00000699-882).
- High energy burden definition, January 4, 2023, (FOMB_PREPA 00023698-699).
- IRP2019 - Ex 1.00 - Main Report REV2. June 7, 2019 (FOMB_PREPA 00024202).
- LUMA letter to Proskauer re CapEx (February 7, 2023), (FOMB_PREPA 00023701-704).
- LUMA Submission of Annual Budget. April 2, 2022 (FOMB_PREPA 00020540-21007).
- "Revenue Envelope and Legacy Charge model.xlsx" (Document ID 235394).

B.2. Publicly available documents

- Alberini, Anna and Massimo Filippini. "Response of residential electricity demand to price: The effect of measurement error." *Energy Economics* 33, no. 5 (2011), pp. 889-895.
- Autoridad de Energia Electrica and Central Office for Recovery, Reconstruction, and Resiliency. *The Grid Modernization of Puerto Rico*, available at:

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- Bonbright, James C. *Principles of Public Utility Rates*. NY: Columbia University Press, 1961.
- Brown, Marilyn A., Anmol Soni, Melissa V. Lapsa, and Katie Southworth. "Low-Income Energy Affordability: Conclusions from a Literature Review." *Oak Ridge National Laboratory* (March 2020).
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- Drehbohl, Ariel, Lauren Ross, and Roxana Ayala. "How High Are Household Energy Burdens?" *American Council for an Energy-Efficient Economy* (September 2020).
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- Feehan, James P. "The long-run price elasticity of residential demand for electricity: Results from a natural experiment." *Utilities Policy* 51 (2018), pp. 12-17.
- Final Resolution and Order. January 10, 2017, CEPR-AP-2015-0001, In Re: Puerto Rico Electric Power Authority Rate Review.
- Flowers, Simon. "How the Russia-Ukraine war is changing energy markets." *Wood Mackenzie News*, February 23, 2023, https://www.woodmac.com/news/the-edge/how-the-russia-ukraine-war-is-changing-energy-markets/.
- Hledik, Ryan, Cody Warner, and Ahmad Faruqui. "Status of Residential Time-of-Use Rates in the US." *Public Utilities Fortnightly*, November 1, 2018.
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- Kuperszmid, Celia and Shannon Baker-Branstetter. "The Fees That Raise Your Electric Bill Even When You Use Less Energy." *Consumer Reports*, March 7, 2016, https://www.consumerreports.org/consumer-protection/fees-that-raise-your-electric-bill-even-when-you-use-less-energy/.

- Labandeira, Xavier, Jose M. Labeaga, and Xiral Lopez-Otero. "A meta-analysis on the price elasticity of energy demand." *Energy Policy* 102 (January 2017), pp. 549-568.
- Lazar, Jim. "Bills and Rates: Implementing the three principles of smart rate design." *American Public Power Association*, August 22, 2019.
- Mooney, Meghan and Katy Waechter. "Puerto Rico Low-to-Moderate Income Rooftop PV and Solar Savings Potential." *National Renewable Energy Laboratory* (December 17, 2020).
- Name Census. "Puerto Rico Population and Demographics," https://namecensus.com/demographics/puerto-rico/.
- News is my Business. "Puerto Rico's electricity grid ranks last in utility performance survey." February 1, 2021, https://newsismybusiness.com/puerto-ricos-electricity-grid-ranks-last-in-utility-performance-survey/.
- Oregon Department of Energy, Oregon Public Utility Commission, and Oregon Housing and Community Services. *Ten-Year Plan: Reducing the Energy Burden in Oregon Affordable Housing*. 2018.
- Puerto Rico Electric Power Authority. *2019 Fiscal Plan for the Puerto Rico Electric Power Authority*, June 27, 2019.
- Puerto Rico Electric Power Authority. *2020 Fiscal Plan for the Puerto Rico Electric Power Authority*, June 29, 2020.
- Puerto Rico Electric Power Authority. *2021 Fiscal Plan for the Puerto Rico Electric Power Authority*, May 27, 2021.
- Puerto Rico Electric Power Authority and US Federal Emergency Management Agency. *PREPA 10-Year Infrastructure Plan, March 2021.Puerto Rico Electric Power Authority*. *Puerto Rico Electric Power Authority Fiscal Plan*, April 28, 2017.
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- Ros, Agustin J. "An Econometric Assessment of Electricity Demand in the United States Using Utility-Specific Panel Data and the Impact of Retail Competition on Prices." *The Energy Journal* 39, no. 2, pp. 73-99.
- Schulte, Isabella Peter Heindl. "Price and income elasticities of residential energy demand in Germany." *Energy Policy* 102 (2017), pp. 512-528.
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commitment-virtual-power-plant-sunnovas-project-hestia?utm_medium=email&utm_source=govdelivery.

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- Zitelman, Kiera and Jasmine McAdams. "The Role of State Utility Regulators in a Just and Reasonable Energy Transition." *National Association of Regulatory Utility Commissioners* (September 2021).

B.3. Legal documents

- *Disclosure Statement for Modified Second Amended Title III Plan of Adjustment of the Puerto Rico Electric Power Authority* (ECF No. 3297). No. 17-BK-3283-LTS and No. 17-BL-4780-LTS. March 1, 2023.
- *Modified Second Amended Title III Plan of Adjustment of the Puerto Rico Electric Power Authority*. No. 17-BK-3283-LTS and No. 17-BL-4780-LTS. March 1, 2023.

B.4. Publicly available data and statistics

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- US Census Bureau (PST045222, Puerto Rico; accessed April 17, 2023). https://www.census.gov/quickfacts/fact/table/PR/PST045222.
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B.5. Other data and statistics

- "Fixed Charge Analysis.xlsx".

Appendix C. Expected T&D CapEx requirements and T&D CapEx shortfalls

Table 7: Expected T&D CapEx requirements and T&D CapEx shortfalls ($ in millions)[134]

Fiscal Year	Total expected annual T&D CapEx requirement [A]	2022 Fiscal Plan T&D CapEx [B]	Additional FEMA cost-share funds [C]	Additional T&D CapEx [D]	T&D CapEx shortfall [E] = A - (B + C + D)	Cumulative T&D CapEx shortfall
			NPV in 2024 of C + D = $887			
2023	$250	N/A	N/A	N/A	N/A	N/A
2024	$254	$155	$50	$0	$49	$49
2025	$258	$178	$50	$0	$30	$79
2026	$262	$181	$50	$0	$31	$110
2027	$266	$184	$50	$0	$33	$143
2028	$270	$187	$50	$0	$34	$177
2029	$275	$190	$50	$0	$35	$212
2030	$279	$193	$50	$0	$36	$248
2031	$283	$195	$50	$0	$38	$286
2032	$287	$198	$50	$0	$39	$325
2033	$292	$201	$50	$0	$40	$365
2034	$296	$204	$0	$92	$0	$365
2035	$301	$207	$0	$93	$0	$365
2036	$305	$211	$0	$95	$0	$365
2037	$310	$214	$0	$96	$0	$365
2038	$316	$218	$0	$98	$0	$365
2039	$322	$222	$0	$100	$0	$365
2040	$328	$226	$0	$102	$0	$365
2041	$334	$231	$0	$103	$0	$365
2042	$340	$235	$0	$105	$0	$365
2043	$347	$239	$0	$107	$0	$365
2044	$353	$244	$0	$109	$0	$365
2045	$360	$248	$0	$111	$0	$365
2046	$366	$253	$0	$113	$0	$365
2047	$373	$258	$0	$116	$0	$365
2048	$380	$262	$0	$118	$0	$365
2049	$387	$267	$0	$120	$0	$365
2050	$395	$272	$0	$122	$0	$365
2051	$402	$278	$0	$125	$0	$365

[134] *Revenue Envelope and Legacy Charge Model.xlsx* at "Additional Capex Projection" tab.

Appendix D. Fuel price forecast comparisons

(115) **Table 8** and **Table 9** below compare the LNG price forecast in the 2022 Fiscal Plan against the 2022 EIA AEO and 2023 EIA AEO forecasts for delivered LNG for electric power, respectively.

Table 8: 2022 Fiscal Plan LNG price forecast vs. 2022 AEO forecast (nominal $/MMBtu)[135]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2022)	Percentage difference
2023	$14.00	$4.08	243%
2024	$10.00	$3.84	160%
2025	$10.00	$3.74	167%
2026	$10.00	$3.83	161%
2027	$10.00	$4.03	148%
2028	$10.00	$4.31	132%
2029	$10.00	$4.52	121%
2030	$10.00	$4.73	112%
2031	$10.00	$4.90	104%
2032	$11.00	$5.04	118%
2033	$11.00	$5.23	110%
2034	$11.00	$5.30	107%
2035	$11.00	$5.38	105%

Table 9: 2022 Fiscal Plan LNG price forecast vs. 2023 AEO forecast (nominal $/MMBtu)[136]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2023)	Percentage difference
2023	$14.00	$6.05	131%
2024	$10.00	$4.94	102%
2025	$10.00	$4.36	129%
2026	$10.00	$3.90	157%
2027	$10.00	$3.63	176%
2028	$10.00	$3.57	180%
2029	$10.00	$3.64	175%
2030	$10.00	$3.77	166%
2031	$10.00	$3.94	154%
2032	$11.00	$4.14	166%
2033	$11.00	$4.41	149%
2034	$11.00	$4.67	136%
2035	$11.00	$4.95	122%

[135] PREPA 2022 Fiscal Plan, Exhibit 61; 2022 Annual Energy Outlook, Table 13, Natural Gas: Delivered Prices: Electric Power: Reference case.

[136] PREPA 2022 Fiscal Plan, Exhibit 61; 2023 Annual Energy Outlook, Table 13, Natural Gas: Delivered Prices: Electric Power: Reference case.

(116) **Table 10** and **Table 11** below compare the Bunker-C (RFO) price forecast in the 2022 Fiscal Plan against the 2022 EIA AEO and 2023 EIA AEO forecasts for delivered RFO for electric power, respectively.

Table 10: 2022 Fiscal Plan RFO price forecast vs. 2022 AEO forecast (nominal $/MMBtu)[137]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2022)	Percentage difference
2023	$23.00	$14.55	58%
2024	$12.00	$15.94	-25%
2025	$10.00	$16.56	-40%
2026	$11.00	$17.18	-36%
2027	$12.00	$18.14	-34%
2028	$12.00	$18.81	-36%
2029	$13.00	$19.40	-33%
2030	$14.00	$19.97	-30%
2031	$14.00	$20.82	-33%
2032	$15.00	$21.41	-30%
2033	$16.00	$22.08	-28%
2034	$16.00	$22.61	-29%
2035	$17.00	$23.17	-27%

Table 11: 2022 Fiscal Plan RFO price forecast vs. 2023 AEO forecast (nominal $/MMBtu)[138]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2023)	Percentage difference
2023	$23.00	$21.09	9%
2024	$12.00	$21.43	-44%
2025	$10.00	$20.70	-52%
2026	$11.00	$21.10	-48%
2027	$12.00	$21.62	-45%
2028	$12.00	$22.08	-46%
2029	$13.00	$22.64	-43%
2030	$14.00	$23.26	-40%
2031	$14.00	$23.85	-41%
2032	$15.00	$24.51	-39%
2033	$16.00	$25.20	-37%
2034	$16.00	$25.91	-38%
2035	$17.00	$26.69	-36%

[137] PREPA 2022 Fiscal Plan, Exhibit 61; 2022 Annual Energy Outlook, Table 12, Nominal Petroleum Prices: Electric Power: Residual Fuel Oil: Reference case. Values were converted from $/gallon to $/MMBtu using the EIA's energy conversion calculator. See https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php.

[138] PREPA 2022 Fiscal Plan, Exhibit 61; 2023 Annual Energy Outlook, Table 12, Nominal Petroleum Prices: Electric Power: Residual Fuel Oil: Reference case. Values were converted from $/gallon to $/MMBtu using the EIA's energy conversion calculator. See https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-

(117) **Table 12** and **Table 13** below compare the diesel price forecast in the 2022 Fiscal Plan against the 2022 EIA AEO and 2023 EIA AEO forecasts for delivered diesel for electric power, respectively.

Table 12: 2022 Fiscal Plan diesel price forecast vs. 2022 AEO forecast (nominal $/MMBtu)[139]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2022)	Percentage difference
2023	$28.00	$21.24	32%
2024	$18.00	$22.23	-19%
2025	$16.00	$22.04	-27%
2026	$17.00	$21.86	-22%
2027	$18.00	$21.88	-18%
2028	$19.00	$22.68	-16%
2029	$20.00	$23.40	-15%
2030	$21.00	$23.96	-12%
2031	$22.00	$24.75	-11%
2032	$23.00	$25.47	-10%
2033	$24.00	$26.08	-8%
2034	$25.00	$26.83	-7%
2035	$26.00	$27.56	-6%

Table 13: 2022 Fiscal Plan diesel price forecast vs. 2023 AEO forecast (nominal $/MMBtu)[140]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2023)	Percentage difference
2023	$28.00	$34.30	-18%
2024	$18.00	$32.80	-45%
2025	$16.00	$30.42	-47%
2026	$17.00	$29.27	-42%
2027	$18.00	$28.07	-36%
2028	$19.00	$26.90	-29%
2029	$20.00	$27.70	-28%
2030	$21.00	$28.49	-26%
2031	$22.00	$29.13	-24%
2032	$23.00	$29.94	-23%
2033	$24.00	$30.64	-22%
2034	$25.00	$31.55	-21%
2035	$26.00	$32.42	-20%

calculators.php.

139 PREPA 2022 Fiscal Plan, Exhibit 61; 2022 Annual Energy Outlook, Table 12, Nominal Petroleum Prices: Electric Power: Distillate Fuel Oil: Reference case. Values were converted from $/gallon to $/MMBtu using the EIA's energy conversion calculator. See https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php.

140 PREPA 2022 Fiscal Plan, Exhibit 61; 2023 Annual Energy Outlook, Table 12, Nominal Petroleum Prices: Electric Power: Distillate Fuel Oil: Reference case. Values were converted from $/gallon to $/MMBtu using the EIA's energy conversion calculator. See https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-

(118) **Table 14** and **Table 15** below compare the coal price forecast in the 2022 Fiscal Plan against the 2022 EIA AEO and 2023 EIA AEO forecasts for delivered coal for electric power, respectively. The coal forecasts end at 2027 because Act 17-2019 requires PREPA to phase out all coal-fired generation by December 31, 2027.[141]

Table 14: 2022 Fiscal Plan coal price forecast vs. 2022 AEO forecast (nominal $/MMBtu)[142]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2022)	Percentage difference
2023	$4.00	$2.10	91%
2024	$6.00	$2.14	180%
2025	$5.00	$2.14	134%
2026	$5.00	$2.16	132%
2027	$5.00	$2.21	126%

Table 15: 2022 Fiscal Plan coal price forecast vs. 2023 AEO forecast (nominal $/MMBtu)[143]

Fiscal Year	2022 Fiscal Plan (March 2022)	EIA AEO (2023)	Percentage difference
2023	$4.00	$2.14	87%
2024	$6.00	$2.19	174%
2025	$5.00	$2.22	125%
2026	$5.00	$2.24	124%
2027	$5.00	$2.26	121%

calculators.php.

141 PREPA 2022 Fiscal Plan, p. 74.

142 PREPA 2022 Fiscal Plan, Exhibit 61; 2022 Annual Energy Outlook, Table 15, Coal Supply: Delivered Prices: Electric Power: Reference case.

143 PREPA 2022 Fiscal Plan, Exhibit 61; 2023 Annual Energy Outlook, Table 15, Coal Supply: Delivered Prices: Electric Power: Reference case.